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Stemfow Induced Soil Nutrient Heterogeneity in a Mixed Mesophytic Forest

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Many studies have found correlations between forest herb distributions and broad-scale differences in soil chemistry or parent material (e.g. Howell and VanKat 1981; Graves and Monk 1982). In addition, within-stand patterns of herb distribution have been related to microhabitat gradients associated with pit-and-mound topography, fallen logs, treefall gaps, and rock outcrops (Bratton 1976; Thompson 1981). In forest stands where such microtopographic features are uncommon, however, canopy tree bases may represent the largest source of variation in forest floor microclimate and topography. While non-random distributions of herb species along complex gradients related to tree bases have been reported (Bratton 1976; Crozier 1983; Crozier and Boerner 1984), the mechanisms producing and maintaining such gradients are not clearly understood.

Stemflow, i.e. precipitation reaching the ground by flowing down tree trunks, has been shown to induce concentric moisture and chemical gradients around tree bases in deciduous forests (Gersper and Holowaychuk 1970, 1971; Parker 1983), and may account for up to 20% of the total dissolved nutrient input to soils near tree bases (Parker 1983). On level silt loam-fine sandy loam soils overlying glacial till in central Ohio, Gersper and Holowaychuk (1970, 1971) found these gradients of soil chemical properties to be the most striking under smooth-barked trees which produced the largest stemflow volumes. In a nearby forest stand of similar tree species composition, but on coarser-textured hillside soils, Crozier and Boerner (1984) found that the spatial distribution pattern of several perennial herb species and soil nutrient levels both differed consistently in plots established around the bases of different tree species. The objectives of this study were (1) to determine the importance of stemflow in establishing such soil nutrient gradients, and (2) to determine if the relationship between bark texture, which partially determines stemflow volume, and soil nutrient gradient intensity demonstrated on fine-grained, fertile soils (Gersper and Holowaychuk 1971) also applied to the coarser, less fertile soils of our study area.

METHODS

The study was carried out in Neotoma Valley, Hocking County, Ohio (30°35′N, 82°33′W), an unglaciated 73 ha watershed underlain by acid sandstone. All sampling was carried out within a 30 × 50 m area on the lower northeast-facing slope occupied by mixed mesophytic forest (Wolfe et al. 1949; Boerner and Crozier 1983) on Neotoma sandy loam soils of moderate pH (4.5–5.7) and low base saturation (10–20%) (Riemenschneider 1964; Boerner 1984a). Only 1% of the sample area was occupied by microtopographic features: in five 30 × 1 m quadrats, exposed rock, pit-and-mound complexes, and fallen logs >15 cm diameter occupied 0.7, 0.2, and 0.1%, respectively, of the forest floor area.

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* to whom correspondence should be forwarded

Stemflow was collected from three canopy *Quercus alba* L. individuals and from two canopy individuals each of *Acer rubrum* L., *Betula lenta* L., *Fagus grandifolia* Ehrl., and *Q. borealis* Michx. This level of replication is equivalent to that used in other stemflow studies (e.g. Gersper and Holowaychuk 1971; one or two trees per species; Kaul and Billings 1965: two or three trees per species).

A polyurethane foam collar was formed around each tree 1 m above ground level, and stemflow was diverted through tygon tubes from the collar into a 21 l covered plastic bucket at the base of the tree (Likens and Eaton 1970). Sampling was carried out weekly from 22 March through 28 August 1982, though more frequent sampling was necessary during high rainfall periods. On each sampling date, volumes were measured, and 100 ml subsamples collected. The buckets were then rinsed with 1.2M HCl and deionized water, then treated with 5 ml of chloroform to prevent algal growth. Stemflow pH was determined immediately upon return to the laboratory, after which the samples were frozen pending analysis. Rainfall was collected in 3 Taylor Clear-Vu rain gauges mounted 1.5 m above a 30 m wide pipeline right-of-way located 150 m upslope from the sample area; rainfall samples were processed as above.

A-horizon soil samples were taken 18 and 28 April from under three canopy individuals each of *A. rubrum, B. lenta, F. grandifolia,* and *Q. alba,* and from one canopy individual each of *Liriodendron tulipifera* and *Q. borealis.* For each tree chosen, samples were taken at 0, 10, 40, and 70 cm from the tree base in each of four compass directions (N, S, E, W). Since little variation among compass directions was found, the four samples from each distance were pooled for data analysis. Five soil samples were also collected from each of seven randomly selected plots which were >2 m from any canopy tree base.

Soil pH was determined in a 1:5 soil:water paste. Nitrate and ammonium were extracted from soil samples with 2M KCl (Bremner 1965) while cations, phosphate, and sulfate were extracted with 1M NH_4OAc (Chapman 1965). Cation concentrations in rainfall, stemflow, and soil extracts were determined by atomic absorption spectrophotometry following addition of La_2O_3 in 6M HCl to a final concentration of 36 mM La (Likens and Bormann 1970). Phosphate was determined by the stannous chloride method, and sulfate by turbidimetry (A.P.H.A. 1976). Nitrate in ammonium in soil extracts were determined by microKjeldahl distillation, with the addition of MgO for ammonium and MgO + Devarda's Alloy for nitrate (Bremner 1965); stemflow and rainfall nitrate were determined using an Orion specific ion electrode while ammonium was measured by the phenate method (A.P.H.A. 1976).

Data were analyzed by linear regression, and analysis of variance followed by Waller-Duncan K ratio post-test (S.A.S. 1982).

RESULTS

The volume of stemflow varied by tenfold among tree species (Table 1). The five species which produced relatively high rates of stemflow had either uniformly smooth bark (*F. grandifolia, B. lenta, A. rubrum*), long vertical plates of smooth bark (*Q. borealis*), or uninterrupted vertical channels (*L. tulipifera*) down which stemflow could move easily. In contrast *Q. alba,* which produced only 12–16% as much stemflow volume as the other five species (Table 1), had rough bark with no continuous plates or channels. The relationship between stemflow volume and bark texture was consistent with other studies of stemflow (Kaul and Billings 1965; Gersper and Holowaychuk 1970, 1971; Parker 1983).

TABLE 1. Mean stemflow volume (l · da^{-1}), stemflow nutrient concentrations (μmol · l^{-1}), and nutrient supply rates from stemflow to the soil surface (μmol · da^{-1}) from six deciduous tree species. Values followed by the same lower case letters were not significantly different, as determined by analysis of variance and plotting of Least Significant Differences ($p = 0.05$); 95% confidence intervals for pH, recalculated from hydrogen ion concentrations, are given in parentheses.

			Calcium		Sulfate		Potassium	
Species	Volume	pH	Concentration	Supply Rate	Concentration	Supply Rate	Concentration	Supply Rate
Quercus alba	0.14 a	5.40 a (5.22–5.70)	900.4 a	99.6	637.4 a	55.1	515.3 a	47.1
Quercus borealis	1.18 b	4.12 b (4.00–4.29)	93.1 c	109.5	124.2 b	249.5	121.0 c	142.7
Betula lenta	1.15 b	3.88 c (3.87–3.89)	33.4 cd	37.7	84.3 b	99.8	77.0 c	90.0
Acer rubrum	0.95 b	4.17 b (3.96–4.60)	117.8 bc	82.6	153.2 b	112.3	182.4 bc	135.3
Liriodendron tulipifera	0.85 b	3.96 bc (3.85–4.11)	175.4 b	142.7	253.1 b	193.4	264.2 b	209.0
Fagus grandifolia	0.86 b	3.93 b (3.91–3.97)	53.4 cd	60.1	116.6 b	141.9	139.6 c	140.7
Ambient Rainfall	–	4.10 bc (3.82–4.21)	14.0 d	–	107.2 b	–	11.8 d	–

Concentrations of phosphate, nitrate, ammonium, and magnesium in stemflow did not vary significantly ($p > 0.10$) among species. Concentrations of calcium, sulfate, potassium, and hydrogen ions (measured as pH) in *Q. alba* stemflow differed significantly, however, from the other five species and from incident rainfall (Table 1). *Q. alba* calcium, sulfate, and potassium stemflow concentrations exceeded those of the other species by 5-28 fold, 3-8 fold, and 2-7 fold, respectively (Table 1). While there were few significant differences in stemflow nutrient concentrations among the other five species, *B. lenta* stemflow had the lowest pH and lowest ionic concentrations. The nutrient concentrations observed in this study were similar to those reported in other eastern deciduous forests (e.g. Kaul and Billings 1965; Gersper and Holowaychuk 1970, 1971).

Nutrient supply rates from stemflow to the soil surface were calculated by summing the products of concentration and volume for each sampling period. Unlike stemflow nutrient concentrations, supply rates were statistically similar among species, since the higher ionic concentrations found in *Q. alba* stemflow samples were offset by higher stemflow volumes in the other species, especially for sulfate (Table 1).

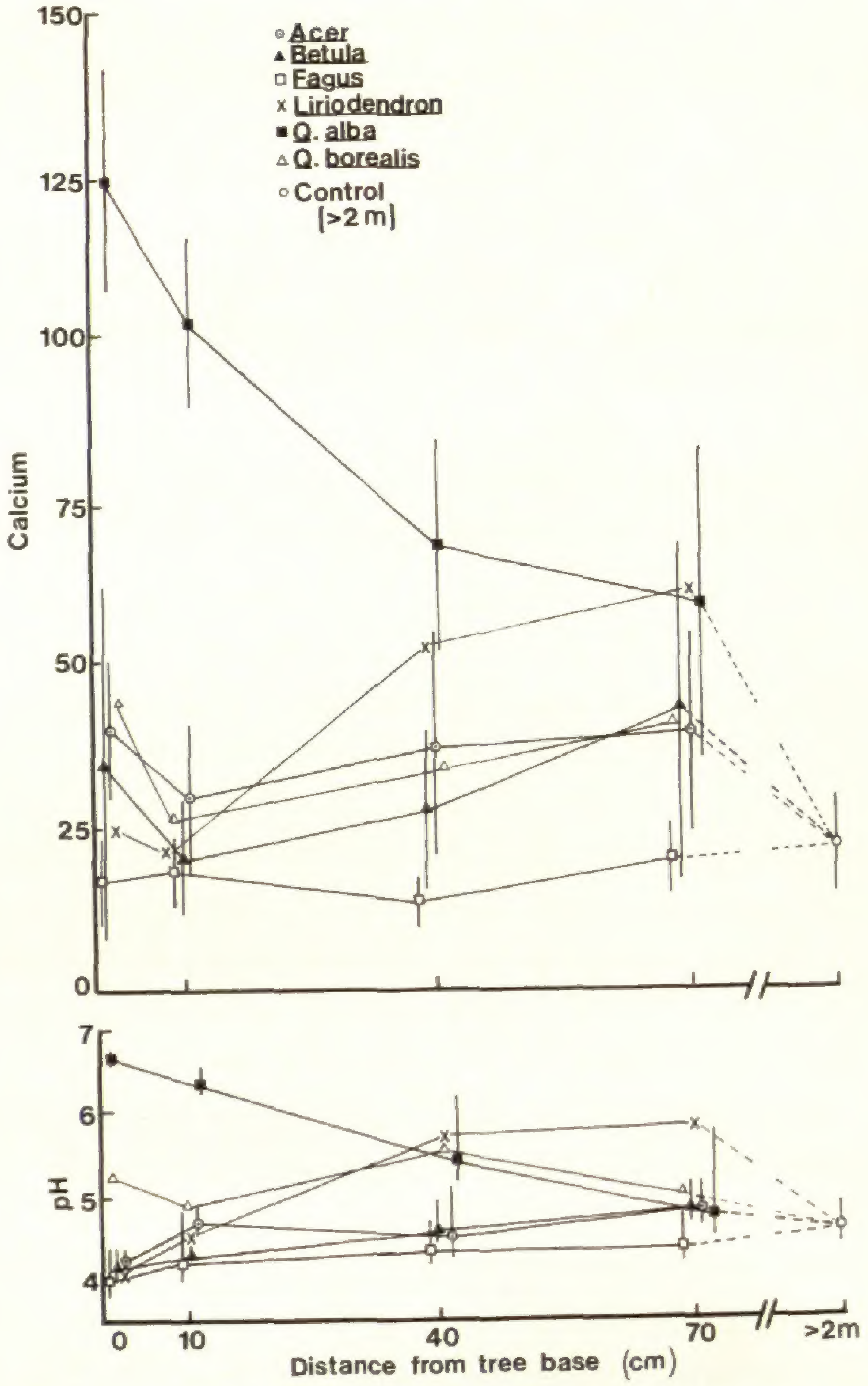

FIG. 1. Calcium concentrations (umol extractable Ca/100 g soil) and pH in soils at different distances from tree bases in a mixed mesophytic forest. Means for each tree species (± one standard error) are given for each distance sampled. Standard error bars for pH are asymmetrical as they were calculated on the basis of hydrogen ion concentrations then transformed to pH.

Regression of soil nutrient concentrations versus distance from tree base revealed no statistically significant gradients of soil chemistry or moisture around the bases of *Q. borealis, L. tulipifera, A. rubrum, B. lenta* or *F. grandifolia* trees, though some depression in soil pH was noted near the bases of large *F. grandifolia* and *B. lenta* individuals (Fig. 1). In contrast, significant ($p < 0.01$) gradients of soil pH, extractable sulfate and extractable calcium were found around the bases of *Q. alba* trees. Calcium, sulfate, and pH were all significantly higher at 0 and 10 cm distances from *Q. alba* bases than at comparable distances from other tree species, or away from trees (Figs. 1 and 2). By 40–70 cm from tree bases, however, concentrations of these elements had decreased to background soil levels. Despite relatively large volumes of water being deposited near tree bases by stemflow, soil moisture did not vary significantly with distance in any species (Fig. 2).

To determine the significance of these nutrient relationships, linear regressions of 0 and 10 cm soil sample concentrations on stemflow concentrations and supply rates were performed. While there were no significant correlations between supply rates and soil concentrations, strong correlations existed between stemflow concentrations and soil concentrations of sulfate ($r^2 = 0.62$), calcium ($r^2 = 0.78$), and hydrogen ions ($r^2 = 0.86$), all significant at $p < 0.01$. This suggested that stemflow additions were likely mechanisms for inducing this surface soil heterogeneity. Since the soil gradients around *Q. alba* trees were the steepest, an alternative hypothesis is that this species establishes preferentially on calcium-sulfate-pH "hot spots." Extensive soil sampling in this valley (Boerner 1984a) has failed to uncover any such "hot spots" either around any other tree species or away from canopy trees. Thus, we feel the correlations between stemflow chemistry and surface soil chemistry establish a potential causal link.

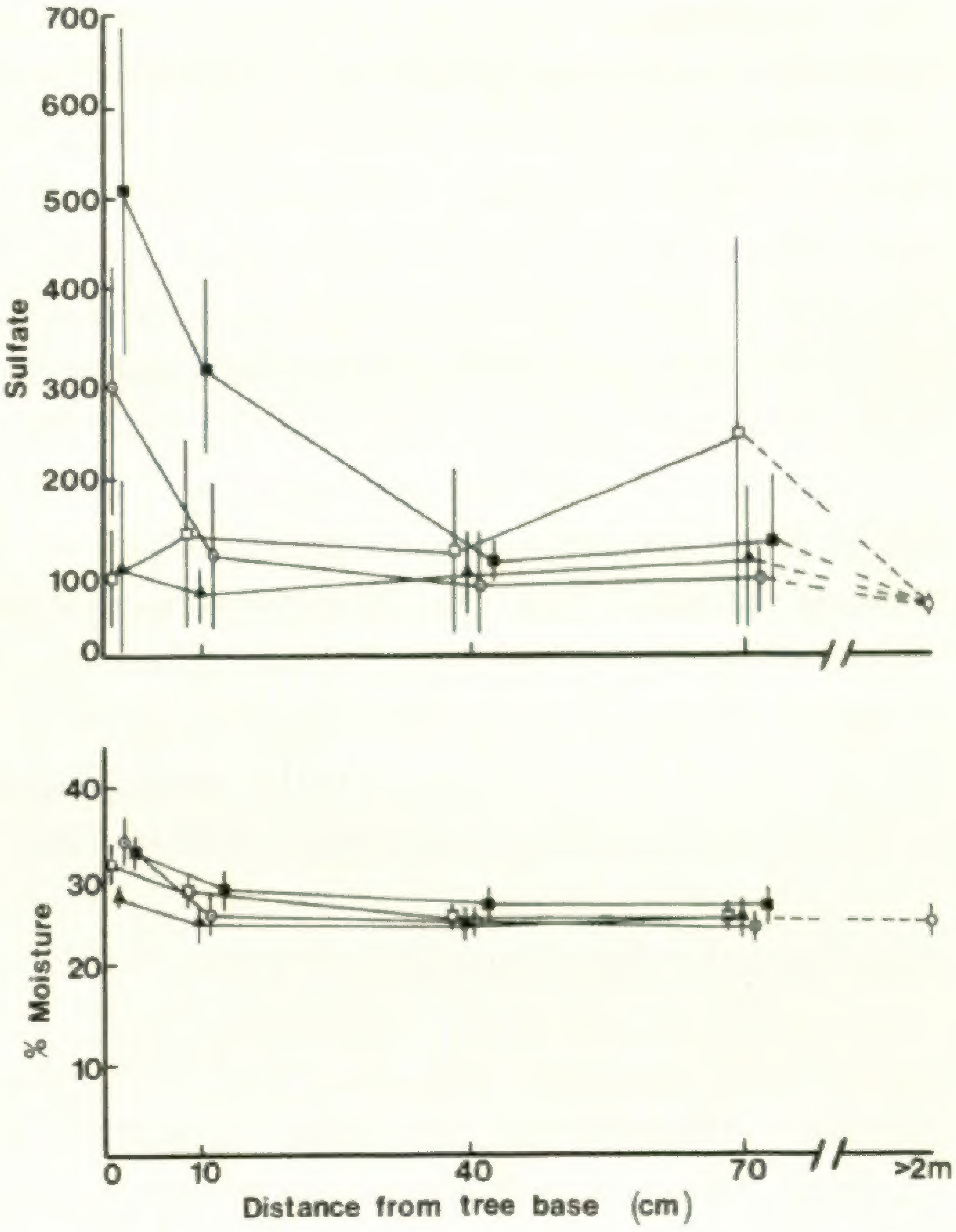

FIG. 2. Sulfate concentrations (umol extractable sulfate/100 g soil) and soil moisture (% by mass) at different distances from tree bases. Means and standard errors are plotted for all species except *Liriodendron tulipifera* and *Quercus borealis*, which showed negligible variation along the distance sampled. Symbols follow Fig. 1.

DISCUSSION

In a study of distribution and reproductive success of spring ephemeral and summer-green herbs in this valley, Crozier and Boerner (1984) found five species of herbs to be significantly associated with *Q. alba* bases, including the local numerical dominant *Geranium maculatum* L. In this study the one tree species for which striking nutrient gradients were observed was *Q. alba*. This species, with its rough bark, had lower stemflow volumes, lower total amounts of sulfate, and similar amounts of calcium added via stemflow, as compared to the other five tree species tested (see Crozier 1983 for relationships between stemflow addition rates and basal area of individuals of each species). In contrast, Gersper and Holowaychuk (1971) reported finding the greatest effect of stemflow on soil chemical properties under smooth-barked trees which produced large volumes of stemflow, especially *Fagus grandifolia*.

In order to visualize how stemflow nutrient and water inputs might affect surface soil characteristics in soils of different textures, both inputs and the potential for leaching losses must be considered. Gersper and Holowaychuk (1970) discussed the importance of the ratio of the stemflow nutrient concentrations to soil nutrient concentrations in determining leaching losses at a given point on the forest floor. Both stemflow and throughfall represent additions of water to the soil surface, and therefore a mechanism for leaching of nutrients, especially anions, from the surface soil horizon. Since higher water percolation leads to higher potential leaching losses (Brady 1974), higher leaching losses are likely to occur in coarser, better-drained soils or at points where stemflow and throughfall water addition rates are the highest.

If a forest floor can, for simplicity, be considered to consist of three types of patches: areas away from trees (>2 m in this study), areas under trees with flaky or rough bark (*Q. alba,* for example), and areas under smooth-barked trees (*Fagus* or *Betula,* for example), then the impact of stemflow on the soil nutrient levels can be visualized. In coarser textured soils which are subject to high leaching rates, areas under rough-barked trees are likely to have the lowest leaching rates, because of the relatively small percentage of incident precipitation which reaches the forest floor as stemflow (Voight 1960). Because these coarse, leached soils are generally lower in exchangeable nutrients (Brady 1974), the relatively high concentrations of nutrients present in stemflow from rough-barked trees are likely to have a large, positive impact on base saturation and pH at these sites. This appeared to be the case for soils under *Q. alba* trees on the sandy loam soils of our study site. These patches had the highest pH and greatest concentrations of extractable calcium and sulfate found in this forest.

Conversely, large volumes of stemflow from smooth-barked trees will add to the leaching of soils near their bases. In our study site, these larger volumes of water did not lead to higher soil moisture levels, indicating the freely draining nature of these relatively coarse soils. These large volumes of stemflow did, however, result in slightly, though not statistically significantly, lower pH near the bases of smooth-barked trees than 40 cm or more away from their bases.

In contrast, in forests with finer-textured soils, where percolation and leaching rates are generally lower, areas adjacent to rough-barked trees and area away from trees are both likely to have lower leaching losses than areas under smooth-barked trees, where stemflow volumes of greater than 15 $1 \cdot da^{-1}$ have been reported (Gersper and Holowaychuk 1971). Gersper and Holowaychuk (1971) reported similar pH levels in areas under a single *Q. alba* tree and areas away from trees (4.9 vs 4.8) on a fine sandy loam/silt loam soil, indicating a similar extent of leaching in these two patch types. Very high leaching losses under smooth-barked trees were noted, however, on both fine sandy loam and silt loam soils, with resultant lower pH and base saturation near the tree bases (Gersper and Holowaychuk 1970, 1971). Thus, on soils with fine texture and higher base saturation, forest floor areas under smooth-barked trees experienced greater leaching losses, and became the unique forest floor patch type, while those under rough-barked trees differed little from the general forest floor.

While stemflow adds relatively small masses of water and nutrients to the forest floor in a narrow annulus around a tree base, the majority of incident rainfall reaches the forest floor as throughfall. This pathway also accounts for a much larger proportion of dissolved nutrient input to the soil surface than does stemflow (Parker 1983), though throughfall inputs are spread widely across the forest floor rather than being concentrated next to tree bases. Thus, species-specific differences in throughfall volume and nutrient concentrations could also play a role in generating the soil nutrient patterns described here. Given, however, the lack of significant differences in nitrogen and phosphorus leaching losses from leaves of *Q. alba, Q. prinus, F. grandifolia,* and *A. rubrum* in laboratory simulations (Boerner 1984b), and the high level of spatial and temporal variability in throughfall fluxes (e.g. Attiwell 1966; Peterson and Rolfe 1979), this pathway seems less likely to generate consistent patterns of nutrient availability near tree bases then stemflow.

In summary, soil water nutrient concentrations under forest canopies may be influenced by stemflow additions as well as by leaching losses due to stemflow and throughfall water. This spatial heterogeneity in surface soil nutrient levels is likely a feature common to mesophytic forests of the eastern U.S. and may play some role in influencing herb distribution patterns (Crozier 1983; Crozier and Boerner 1984), though the relative importance of this source of heterogeneity to herb distribution will also depend on the frequency of other microtopographic features such as pit-and-mound complexes and treefalls. Although stemflow induced nutrient gradients are probably common, the texture of the soil present at the site is likely to determine which tree species will develop these nutrient gradients. Since available soil nutrient levels are influenced both by inputs and losses, both nutrient addition rates and leaching rates characteristic of different patches within a site need to be understood in order to predict the impact of stemflow on the available soil nutrient levels within a site.

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Trees and Shrubs of Columbia County, Pennsylvania

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Columbia County consists of approximately 479 square miles located in east-central Pennsylvania. It is bordered by Luzerne County on the east, Sullivan County on the north, Lycoming County on the northwest, Montour County on the west, Northumberland County on the southwest, and Schuylkill County on the south and southeast. The county is relatively long and narrow with north-south borders being separated by a distance almost twice as great as east-west borders.

Columbia County is located in the Ridge and Valley Province. Its uneven topography is partially the result of differential erosion of the underlying rocks which created ridges of sandstone and valleys of shale and limestone. The results of glacial activity are evidenced in the northern part of the county. Most of Columbia county lies between two major mountainous elevations. North Mountain on the north and Big and Little Mountains on the sourth. These run roughly parallel to one another in a general east-west pattern.

Several other mountains also extend into the county. North Mountain has the greatest elevation rising approximately 2,450 feet above sea level; it forms the eastern border of the Allegheny Mountains. Most of the other major mountains attain elevations of 1600 to 1900 feet above sea level. Many of the smaller mountains that create a characteristic hilly landscape in the county rise approximately 800 or 900 feet above sea level. The valley floors are 600 or 700 feet above sea level, except in the flood plains adjacent to the Susquehanna River which flows east-west where the elevation is generally 500 feet or less. The lowest point near the Columbia-Montour county line is 460 feet above sea level. The varied topography is conducive to diverse vegetational growth with rich lowlands bordered by towering forests.

Field studies of the county's flora have been undertaken by H. A. Wahl, E. T. Wherry, D. Berkheimer, E. E. Honey, W. E. Manning, E. Gress, J. Coulton, H. Wilkens, E. Morel, H. Meredith, J. Adams, R. Pohl, and others. Extensive examinations of distribution maps and voucher specimens were conducted by me at the herbaria of the Pennsylvania State University and the University of Pennsylvania. Many voucher specimens are filed in my herbarium. Results of studies of native flora conducted by Dr. James Montgomery at the Susquehanna Steam Electric Station near Berwick were also consulted.

The Deciduous Forest Formation, which incorporates the vegetation of Columbia County, is characterized by a dominance of woody angiosperms with interspersed conifers, subordinate shrubs and herbs. Forming the canopy are species of *Quercus, Acer, Carya, Betula* and *Pinus*. Understory woody plants are primarily species of *Prunus, Hamamelis, Sassafras, Virburnum, Amelanchier* and *Cornus*. The listed families of the major groups of vascular plants know to occur in the county follow the sequence in *Gray's Manual of Botany* by M. L. Fernald. An estimate of frequency is applied to each species and variety employing the following categories: common, frequent, occasional and rare. In establishing distribution patterns and frequencies, collections in fringe areas of adjacent counties were taken into consideration.

TAXACEAE: *Taxus canadensis,* occasional in rich woods in adjacent counties and known from a single county collection.

PINACEAE: *Juniperus virginiana,* occasional, dry calcareous slopes and open fields. *Larix leptolepis,* occasionally planted. *Picea abies,* occasional, ornamental introduced from Europe and sometimes spreading from cultivation. *Picea mariana,* rare on cool slopes and in swamps. *Pinus banksiana,* rare. *Pinus pungens,* rare. *Pinus resinosa,* occasional, dry to moist woods and in reforestation plantings. *Pinus rigida,* frequent, dry mixed woods and rocky slopes. *Pinus strobus,* common in the county and in adjacent counties, habitats range from moist woods and rich lower portions of slopes to high knolls, early invader in waste fields. *Pinus sylvestris,* frequent in reforestation plantings, introduced from Europe. *Pinus virginiana,* occasional on barren open ground. *Thuja occidentalis,* rare, moist open areas. *Tsuga canadensis,* common in the county and in adjacent counties, often developing in moist lowlands and ascending rocky slopes.

LILIACEAE: *Smilax rotundifolia,* common throughout the county in hedgerows, meadows, open woods and roadsides.

SALICACEAE: *Populus deltoides,* occasional, river banks and alluvial lowlands. *Populus grandidentata,* common, hedgerows, waste fields, thickets, and borders of woods. *Populus nigra* var. *italica,* rare, escaping from cultivation into fields and roadsides, introduced from Europe. *Populus tremuloides,* common, pioneer tree in waste fields, common in thickets, hedgerows, and borders of woods. *Salix discolor,* occasional, meadows and roadbanks. *Salix gracilis* var. *texteris,* rare in meadows and swamps. *Salix humilis,* frequent, open waste fields and thickets. *Salix interior,* occasional, alluvial soils. *Salix nigra,* frequent, banks of streams and wet thickets. *Salix rigida,* frequent, shores, swamps, and wet thickets. *Salix rigida* var. *angustata,* occasional, stream and river banks. *Salix sericea,* frequent, stream banks and wet thickets.

MYRICACEAE: *Comptonia peregrina,* common, waste fields, roadsides.

JUGLANDACEAE: *Carya cordiformis,* common, hedgerows, flood plain forest. *Carya glabra,* frequent, dry woods and slopes. *Carya ovalis,* frequent, woods and hedgerows. *Carya ovata,* frequent, dry to moist woods and hedgerows. *Carya tomentosa,* in woods. *Juglans cinera,* flood plain forest along Susquehanna River. *Juglans nigra,* frequent, rich woods, hedgerows, and cultivated areas.

CORYLACEAE: *Alnus rugosa,* frequent, margins of streams, brushy swamps, and low wet thin woods. *Alnus serrulata,* common, wet soils along the river and streams, wet thickets and swamps. *Alnus serrulata* var. *subelliptica,* occasional, wet soils. *Betula lenta,* common in dry to rich woods and wooded stream banks. *Betula lutea,* frequent, rich low woods. *Betula nigra,* common, alluvial soils and banks of the Susquehanna River and streams throughout the county. *Betula papyrifera,* occasional, woods in northern portions of county. *Betula populifolia,* frequent, slopes and low grounds, thickets, and roadbanks, a pioneer in waste fields, more concentrated toward the eastern portion of the county. *Carpinus caroliniana,* common understory tree in dry to moist woods. *Corylus americana,* common, thickets, roadsides, and stream banks. *Corylus cornuta,* occasional, rich thickets and borders of woods. *Ostrya virginiana,* common in rich woods and on stream banks.

FAGACEAE: *Castanea dentata,* common, immature trees common in moist and dry woods, hedgerows, and brushy roadsides. *Castanea pumila,* rare. *Fagus grandifolia,* frequent, rich woods, especially in the northern portion of the county. *Quercus alba,* common, dry to moist woods and hedgerows. *Quercus bicolor,* occasional, wet woods.

Quercus coccinea, frequent, dry woods and hedgerows. *Quercus ilicifolia,* common, dry sandy and rocky woods, waste fields, hedgerows, and roadbanks. *Quercus palustris,* frequent, moist woods and lowlands. *Quercus prinoides,* rare, dry woods. *Quercus prinus,* common on rocky slopes of upland woods, overgrown hedgerows, and clearings. *Quercus rubra,* common, most frequently in dry upland woods and hedgerows. *Quercus velutina,* common, dry to moist woods and hedgerows.

ULMACEAE: *Celtis occidentalis* var. *canina,* common in flood plain forest. *Celtis tenuifolia,* occasional, dry to moist woods. *Ulmus americana,* common in lower areas. *Ulmus rubra,* common, rich woods, hedgerows, and stream banks. *Ulmus pumila,* rare, introduced from Asia and often cultivated.

MORACEAE: *Morus alba,* frequent, spreading freely from cultivation to rich soils, more concentrated south of Columbia County.

BERBERIDACEAE: *Berberis thunbergii,* occasional, fields, roadsides, and thickets, introduced from Asia.

MAGNOLIACEAE: *Liriodendron tulipifera,* frequent, rich woods. *Magnolia acuminata,* occasional, especially in southern part of county.

LAURACEAE: *Lindera benzoin,* common, moist woods, meadows, and stream banks. *Sassafras albidum,* common understory tree in sparse woods, margins of rich woods, and overgrown waste fields.

SAXIFRAGACEAE: *Hydrangea arborescens,* frequent, rich woods, moist thickets, and stream banks. *Ribes americanum,* to be expected occasionally in rich thickets. *Ribes cynosbati,* occasional, open woods and moist roadbanks. *Ribes rotundifolium,* frequent, higher rocky woods and clearings.

HAMAMELIDACEAE: *Hamamelis virginiana,* common understory shrub in deciduous and mixed woods, and plentiful in thickets and hedgerows.

PLATANACEAE: *Platanus occidentalis,* frequent in rich moist soils of lowlands and along streams.

ROSACEAE: *Amelanchier arborea,* common understory tree of deciduous woods, also inhabits hedgerows and wooded roadsides. *Amelanchier laevis,* frequent, dry to moist thickets and borders of woods. *Amelanchier stolonifera,* occasional, acid dry open soils. *Crataegus chrysocarpa,* occasional, margin of woods and hedgerows. *Crataegus punctata,* frequent, margins of woods and hedgerows and overgrown waste fields. *Crataegus succulenta,* occasional, dry rocky soil of thickets and borders of woods. *Physocarpus opulifolius,* common in flood plain thickets. *Prunus americana,* occasional, thickets, hedgerows, and borders of woods. *Prunus avium,* occasional, spreading from cultivation to roadsides and fields, naturalized from Eurasia. *Prunus depressa,* rare, calcareous slopes. *Prunus pensylvanica,* frequent, dry woods, hedgerows, and thickets. *Prunus perisca,* rare, roadbanks and hedgerows, escapes from cultivation, introduced from Asia. *Prunus serotina,* common in deciduous and mixed woods, hedgerows, wooded roadsides, and along stream banks. *Prunus virginiana,* common at margins of woods along roadsides and in hedgerows, pioneer in waste fields. *Pyrus arbutifolia,* occasional in wet thickets. *Pyrus communis,* rarely escaping from cultivation into thin woods and hedgerows, introduced from Eurasia. *Pyrus coronaria,* occasional, low woods, wooded slopes, and thickets *Pyrus floribunda,* occasional. *Pyrus malus,* occasional, escaping from cultivation into thin woods, thickets, hedgerows, and waste fields, naturalized from Eurasia. *Pyrus melanocarpa,* occasional, dry rocky thickets and clearings. *Rosa carolina,* frequent, waste fields, roadsides, along hedgerows, and margins of woods. *Rosa multiflora,* occasional, meadows, roadsides, and borders of woods, naturalized from e. Asia. *Rubus allegheniensis,* common in waste fields, along roadsides, in thickets and clearings. *Rubus flagellaris,* frequent, dry fields, clearings, and thickets. *Rubus hispidus,* frequent, moist to dry waste fields, roadsides, and open woods. *Rubus idaeus* var. *strigosus,* occasional, waste fields and thickets. *Rubus occidentalis,* common, rich thickets, hedgerows, and borders of woods. *Rubus odoratus,* frequent, moist shaded borders of woods, thickets, and hedgerows. *Rubus pensilvanicus,* occasional. *Rubus pensilvanicus* forma *phyllophirus,* occasional in thickets and clearings. *Rubus plicatifolius,* rare, dry fields. *Rubus roribaccus,* rare in dry woods. *Spiraea alba,* rare. *Spiraea latifolia,* common in meadows and low grounds, frequently forming dense thickets.

LEGUMINOSAE: *Gleditsia triacanthos,* rare, cultivated tree along streets and in yards. *Robinia pseudo-acacia,* frequent, thickets and margins of woods. *Wisteria frutescens,* rare, escaped from cultivation.

RUTACEAE: *Xanthoxylum americanum,* rare, limestone woods.

SIMAROUBACEAE: *Ailanthus altissima,* frequent in the southern portion of the county, spreading from cultivation into waste places, introduced from Asia.

ANACARDIACEAE: *Rhus copallina* var. *latifolia,* frequent, dry woods, thickets, and rocky banks. *Rhus glabra,* frequent, overgrown waste fields and roadsides. *Rhus radicans,* frequent, fields, thickets, hedgerows, and flood plain forests. *Rhus typhina,* common in hedgerows, thickets, and at margins of woods, pioneer woody plant of waste fields. *Rhus vernix,* rare, swamps and wet thickets.

AQUIFOLIACEAE: *Ilex laevigata,* rare, wooded swamps, approaches western limits in county. *Ilex montana,* occasional, moist woods and meadows. *Ilex verticillata,* frequent, swamps, margins of moist woods, and wet thickets.

CELASTRACEAE: *Celastrus scandens,* common, waste fields, roadbanks, hedgerows, stream banks, and thickets.

STAPHYLEACEAE: *Staphylea trifolia,* occasional in rich thickets and river flood plain forests.

ACERACEAE: *Acer negundo,* occasional on river banks and alluvial soils. *Acer nigrum,* occasional in flood plain forests along Susquehanna River. *Acer pensylvanicum,* frequent, understory tree in rich woods, thickets. *Acer platanoides,* occasional cultivated tree along streets, sometimes escaping into waste areas, introduced from Europe. *Acer pseudo-platanus,* rare, introduced from Europe. *Acer rubrum,* common tree of moist and dry woods, hedgerows, wooded roadsides and stream banks. *Acer rubrum trilobum,* occasional, wet woods and swamps, dry upland slopes. *Acer saccharinum,* frequent, alluvial lowlands and banks of streams, planted along streets and in yards. *Acer saccharum,* common in rich woods. *Acer spicatum,* occasional, cool woods of slopes.

RHAMNACEAE: *Ceanothus americanus,* frequent, dry open woods, overgrown waste fields and rocky banks.

VITACEAE: *Parthenocissus inserta,* rare in woods and thickets. *Parthenocissus quinquefolia,* common, rich woods, thickets, hedgerows, and roadbanks. *Vitis aestivalis,* occasional, dry to moist woods and thickets. *Vitis labrusca,* common, moist to dry thickets, woods, and wooded roadsides. *Vitis riparia,* frequent, river and stream banks and rich thickets.

TILIACEAE: *Tilia americana,* common, rich woods and hedgerows, wooded stream banks. *Tilia neglecta,* rare, rich woods. *Tilia heterophylla,* rare, rich woods.

MALVACEAE: *Althaea rosea,* rare, ornamental escaping to roadsides from cultivation.

NYSSACEAE: *Nyssa sylvatica,* common species of low acid woods but also inhabiting higher woodlands, wooded roadsides, and hedgerows.

CORNACEAE: *Cornus alternifolia,* frequent, dry to moist borders of woods, thickets, and thin woods. *Cornus amomum,* common, varied habitats including wet to moderately dry fields, roadsides, borders of woods, hedgerows, and thickets. *Cornus florida,* common understory tree in deciduous and mixed woods, also inhabits overgrown waste fields, wooded roadsides, and thickets. *Cornus racemosa,* common, waste fields, dry thickets, and rocky slopes, occasionally in moist situations, including the river bank. *Cornus rugosa,* occasional, dry overgrown waste fields and thin woods.

ERICACEAE: *Gaylussacia baccata,* occasional, dry to moist woods, thickets, clearings. *Gaylussacia frondosa,* rare. *Kalmia angustifolia,* occasional, sterile soils, thickets, and waste fields, approaches western limits in this portion of state. *Kalmia latifolia,* common, deciduous and mixed woods of slopes and lowlands, frequently associated with hemlock, also thickets and stream banks. *Rhododendron nudiflorum,* frequent, moist woods, stream banks, and swamps. *Rhododendron roseum,* occasional, dry thickets, hedgerows, and woods. *Vaccinium angustifolium,* occasional. *Vaccinium angustifolium* var. *hypolasium,* occasional, sterile soil, including strip mine banks. *Vaccinium atrococcum,* occasional, swamps and lowlands. *Vaccinium corymbosum,* occasional wet fields and thickets. *Vaccinium stamineum,* common, dry woods, thickets, and clearings. *Vaccinium stamineum* var. *interius,* rare, dry areas. *Vaccinium vacillans,* frequent, dry open woods, thickets, and clearings. *Vaccinium vacillans* var. *crinitum,* occasional, dry areas.

OLEACEAE: *Fraxinus americana,* common, rich woods and hedgerows. *Fraxinus pennsylvanica,* occasional, low woods and stream banks. *Fraxinus pennsylvanica* var. *subintegerrima,* rare along streams. *Ligustrum obtusifolium,* rare, roadsides and borders of woods, naturalized from Japan. *Syringa vulgaris,* rare, cultivated plant near abandoned buildings, introduced from Europe.

BIGNONIACEAE: *Catalpa bignonioides,* occasional, escapes from cultivation. *Catalpa speciosa,* rare.

RUBIACEAE: *Cephalanthus occidentalis,* frequent in the southern and western portions of the county along streams and in moist soils.

CAPRIFOLIACEAE: *Diervilla lonicera,* common, dry to moist wooded roadsides, dry to moist woods, clearings, and thickets. *Lonicera canadensis,* occasional, cool high woodlands. *Lonicera japonica,* frequent, thickets, roadsides, borders of woods, and hedgerows, naturalized from Asia. *Lonicera morrowi,* rare to occasional. *Sambucus canadensis,* common, wet and rich soils of thickets, waste fields, hedgerows, and borders of woods. *Sambucus pubens,* occasional, woods, thickets, and clearings. *Symphoricarpos orbiculatus,* rare. *Viburnum acerifolium,* common, dry to moist rich woods, thickets, and overgrown roadbanks. *Viburnum alnifolium,* frequent, woods and thickets in the northern portion of the county and in more northern counties. *Viburnum cassinoides,* occasional, moist thickets and borders of woods. *Viburnum prunifolium,* occasional, thickets, borders of woods, and shores. *Viburnum recognitum,* common, moist to dry thickets, roadbanks, hedgerows, and stream banks.

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New Records of Vascular Plants from Blair County, Pennsylvania

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Blair County, located in south-central Pennsylvania, has generally been overlooked by collectors. The relative scarcity of plant records from the county, particularly in comparison to neighboring counties, is evident upon examination of the *Atlas of the Flora of Pennsylvania* (Wherry et al. 1979). In addition, from herbarium studies it is clear that most of the documented records have resulted from sporadic field trips and the exploration of only a few of the more accessible sites.

In order to advance the knowledge of the vascular flora of Blair County, from 1976 to 1983 the senior author conducted an intensive field survey within the county augmented by an herbarium and literature search (Kunsman 1984). This paper presents an annotated list of taxa collected during these investigations which represent new records from Blair County.

COUNTY DESCRIPTION

Blair County consists of 137,272 hectares. The topography is hilly to mountainous with elevations ranging from 220 to 900 meters. Approximately two-thirds of the land area is forested.

The western border of the county is situated on Allegheny Mountain and is included within the Allegheny Plateau Province. The terrain of this elevated section, marked by a prominent eastern escarpment, is rolling except where streams have created deep gaps. This province is chiefly underlain with sandstones. The majority of the county lies within the Ridge and Valley Province, characterized by narrow elongate ridges and rolling to hilly valleys. The upper slopes and summits of the ridges consist mainly of sandstones, while shales and limestones predominate on the lower slopes and in the valleys.

Blair County lies within the Susquehanna River Drainage Basin. The major streams of the county are the Frankstown Branch of the Juniata River and the Little Juniata River. The county possesses a continental climate with warm summers, cold winters, and precipitation well-distributed throughout the year. Average daily temperatures range from −2.5°C in January to 22°C in July. Annual precipitation averages 92 centimeters (Merkel 1981). Due to the varied topography and geology, elevational range, and geographic location, a number of plant communities occur within the county.

RESULTS

Based upon the distribution maps of the *Atlas*, the study yielded 536 new records (including 364 dicots, 153 monocots) of species, infraspecific taxa, and hybrids from Blair County. While the great majority of the plants listed below were discovered during the senior author's field work, a few represent collections of previous workers which were not included in the *Atlas*. Most of the following taxa were to be expected in Blair County; others, however, are of special interest because of rareness or phytogeographic considerations.

Synonyms are provided if the nomenclature differs from that of the *Atlas*. Non-native taxa are labeled with an asterisk. The typical habitat for each taxon is given, and unless otherwise noted, each taxon was collected at three or more stations in the county. Voucher specimens are deposited in the Herbarium of The Pennsylvania State University or in the personal collection of John Kunsman.

LYCOPODIOPHYTA

ISOETACEAE: *Isoetes,* submerged in shallow water in stream and reservoir, two stations; a satisfactory determination could not be made for either specimen.

LYCOPODIACEAE: *Lycopodium clavatum,* acid woods, thickets, and clearings. *L. inundatum,* seepy sandy ground, particularly on abandoned mine sites.

SELAGINELLACEAE: *Selaginella apoda,* ditches, springy places, and lawns.

EQUISETOPHYTA

EQUISETACEAE: *Equisetum hyemale,* moist bottomlands, streambanks and ditches. *E. sylvaticum,* seepy acid woods, two stations.

POLYPODIOPHYTA

HYMENOPHYLLACEAE: *Trichomanes,* moist shaded rocks, one station; the gametophyte of a species of this genus has been found in the county (Farrar, Parks, and McAlpin 1983).

OPHIOGLOSSACEAE: *Botrychium oneidense,* moist woods and streambanks.

OSMUNDACEAE: *Osmunda cinnamomea,* seepy acid woods, thickets, and streambanks.

POLYPODIACEAE (s.l.): *Asplenium × ebenoides,* moist limestone ledge, one station. *A. montanum,* shaded sandstone cliff, one station. *Athyrum felix-femina* (L.) Roth var. *asplenioides* (Michx.) Farw. [*A. asplenioides*], rich moist woods, one station. *Cryptogramma stelleri,* moist calcareous ledge, one station; a southern range extension in central Pennsylvania. *Cystopteris protrusa,* rich wooded bottomland, one station. *Dryopteris × boottii,* wet woods, one station. *Thelypteris palustris,* var. *pubescens,* marshes, shorelines, and wet thickets. *T. phegopteris* (L.) Slosson [*Phegopteris connectilis*], moist woods and streambank, two stations.

PINOPHYTA

PINACEAE: *Pinus pungens,* dry rocky slopes and abandoned fields. *P. sylvestris,** dry clearings and thickets.

MAGNOLIOPHYTA–MAGNOLIOPSIDA

ACERACEAE: *Acer campestre,** thickets and brushy fields, particularly on limestone, a western range extension into central Pennsylvania. *A. platanoides,** woods borders, thickets, and disturbed ground.

ANACARDIACEAE: *Rhus copallina,* dry woods borders, thickets, and clearings. *Toxicodendron vernix* (L.) Kuntze [*Rhus vernix*], wet woods, one station.

ANNONACEAE: *Asimina triloba,* moist woods and streambanks, two stations.

APOCYNACEAE: *Apocynum sibiricum,* rocky disturbed ground, one station. *Vinca minor,** disturbed ground, particularly on road banks and woods borders.

AQUIFOLIACEAE: *Ilex montana* var. *montana,* acid woods, rocky slopes, and thickets. *I. verticillata,* shorelines, streambanks, and wet thickets.

ARISTOLOCHIACEAE: *Aristolochia macrophylla* Lam. [*A. durior*],* rocky limestone slope, probably an escape, one station. *A. serpentaria,* rocky limestone woods. *Asarum canadense* var. *reflexum,* moist wooded slope, one station.

ASCLEPIADACEAE: *Asclepias amplexicaulis,* dry sandy woods opening, one station. *A. verticillata,* dry brushy limestone slopes, two stations. *A. viridiflora* var. *viridiflora,* dry brushy limestone slopes, two stations. *A. viridiflora* var. *lanceolata,* dry brushy limestone slope, one station.

BERBERIDACEAE: *Berberis vulgaris,** rocky limestone thicket and woods border, two stations.

BETULACEAE: *Alnus rugosa,* wet thickets, streambanks, and shorelines. *Betula pendula* Roth [*B. alba*],* brushy shoreline and thicket, two stations. *B. populifolia,* dry thickets, clearings, and disturbed ground. *Corylus americana,* thickets, woods borders, and rocky slopes.

BIGNONIACEAE: *Catalpa speciosa,** moist woods, thickets, and streambanks, probably more frequent in Pennsylvania than indicated in the *Atlas.*

BORAGINACEAE: *Cynoglossum virginianum,* dry open woods, one station. *Hackelia virginiana,* moist woods, thickets, and bottomlands. *Lappula echinata,** disturbed ground, one station. *Lithospermum arvense,** disturbed ground, particularly in dry fields and clearings. *L. canescens,* dry brushy slope, one station. *L. latifolium,* moist rocky woods, two stations, a northeastern range extension in Pennsylvania. *Myosotis scorpioides,** disturbed ground, particularly on streambanks and seepy places. *M. verna,* dry open shale slope, one station.

CALLITRICHACEAE: *Callitriche verna* L. [*C. palustris*], submerged in stream, one station.

CANNABINACEAE: *Cannabis sativa,** road shoulder, one station.

CAPRIFOLIACEAE: *Lonicera × bella,** thickets and woods borders, two stations. *L. dioica* var. *glaucescens,* rocky limestone woods and ledges. *L. maackii,** thicket and abandoned field, two stations. *L. morrowii,** thickets, bottomlands, and disturbed ground. *Symphoricarpos albus* var. *albus,* brushy limestone slopes and ledges. *Triosteum aurantiacum,* moist woods, thickets, and streambanks, particularly on limestone. *T. perfoliatum,* moist woods and streambank, two stations. *Viburnum opulus,** thickets and woods borders.

CARYOPHYLLACEAE: *Agrostemma githago,** road shoulder, one station. *Cerastium arvense* var. *arvense,* weed in lawn, one station. *C. arvense* var. *villosum,* limestone ledge, one station. *Minuartia michauxii* (Frenzl.) Farw. [*Arenaria stricta*], rocky limestone slopes and ledges. *Paronychia fastigiata* var. *paleacea,* dry rocky slope, one station, probably more frequent in Pennsylvania than indicated in the *Atlas. P. montana,* dry shaly woods and banks. *Sagina procumbens,* sandy or rocky shorelines, two stations, reported for Bedford County (Henry 1978). *Silene caroliniana* var. *pensylvanica,* open shaly bank, one station. *S. dichotoma,** roadside bank, one station. *S. noctiflora,** roadside banks, two stations. *S. stellata,* dry woods, thickets, and rocky slopes. *Stellaria calycantha* var. *isophylla,* springy ground in cool woods, one station. *S. longifolia,* wet woods, thickets, and bottomlands.

CELASTRACEAE: *Euonymus atropurpureus*, moist limestone woods and ledges.

CHENOPODIACEAE: *Atriplex patula*, disturbed ground, particularly on road shoulders. *Chenopodium botrys*,* disturbed ground, particularly on railroad embankments. *Salsola kali*,* railroad embankments, two stations, first records for the Ridge and Valley Province in central Pennsylvania.

CISTACEAE: *Helianthemum canadense*, dry sandy clearing, one station. *Lechea intermedia*, dry shaly woods, one station. *L. pulchella* Raf. [*L. leggettii*], dry sandy woods, one station. *L. racemulosa*, dry sandy clearing, one station.

COMPOSITAE (ASTERACEAE): *Achillea millefolium* forma *rosea*,* shoreline of pond, one station. *Ambrosia trifida* forma *integrifolia*, bottomlands, streambanks and moist disturbed ground. *Antennaria parlinii* ssp. *parlinii*, dry opening and rocky slope, two stations. *A. parlinii* ssp. *fallax*, (Greene) Bayer & Stebbins [*A. fallax*], open shaly woods, one station. *A. virginica*, open shaly bank, one station. *Artemisia vulgaris*, disturbed ground, particularly on railroad embankments. *Aster acuminatus*, cool moist woods and streambanks. *A. cordifolius*, rocky wooded slopes and thickets. *A. infirmus*, dry acid woods and barrens. *A. novae-angliae* forma *novae-angliae* and forma *roseus*, clearings, thickets and woods borders. *A. oblongifolius*, limestone ledges and rocky slopes. *A. patens* var. *phlogifolius*, rocky limestone woods. *A. pilosus* var. *demotus*, abandoned fields, clearings, and thickets. *A. schreberi*, open rocky limestone banks, two stations. *A. umbellatus*, wet thickets, streambanks, and clearings. *A. undulatus*, dry sandy woods, one station. *Bidens polylepis*,* abandoned field and open ditch, two stations. *Brickellia eupatorioides* (L.) Shinners [*Kuhnia eupatorioides*], rocky limestone openings and banks, two stations. *Centaurea nigra*,* dry sandy clearing, one station. *Cirsium arvense* var. *arvense*,* disturbed ground. *C. arvense* var. *vestitum*,* road shoulder, one station. *C. discolor*, railroad embankments and abandoned fields. *C. muticum*, wet thickets, marshes, and bottomlands. *C. pumilum*, dry open banks and clearings. *Erigeron philadelphicus*, clearings, lawns, and disturbed ground. *Eupatorium altissimum*, disturbed ground, particularly on road shoulders and railroad embankments. *E. fistulosum* forma *albidum*, moist ditch, one station. *E. serotinum*, disturbed ground, first records for the Ridge and Valley Province in south-central Pennsylvania. *E. sessilifolium*, dry open slopes and rocky banks. *Gnaphalium obtusifolium*, clearings, fields, and disturbed ground. *G. uliginosum*, ditches, streambanks, and dried-up water holes. *Helenium autumnale*, bottomlands and streambanks. *H. flexuosum*,* sandy shoreline of reservoir, one station. *Helianthus annuus*,* disturbed ground, particularly on road shoulders. *H. strumosus* dry clearing and woods border, two stations. *Hieracium aurantiacum*,* weed in lawn and woods opening, two stations. *H. traillii* Greene, dry shaly woods and banks, not included in the *Atlas*. *Hypochoeris radicata*,* weed in lawn, one station. *Lactuca biennis* forma *biennis* and forma *integrifolia*, road shoulders, woods borders, and disturbed ground. *L. hirsuta* var. *sanguinea*, dry sandy clearing, one station. *L. saligna*,* road shoulder, one station. *L. serriola* L. forma *integrifolia* (Bogenh.) G. Beck [*L. scariola* var. *integrata*],* disturbed ground, particularly on road shoulders. *Lapsana communis*,* streambanks, bottomlands, and road shoulders. *Liatris scariosa*, open rocky woods, one station. *Picris hieracioides*,* road bank and cultivated ground, two stations. *Prenanthes alba*, rocky woods, one station. *Rudbeckia hirta* var. *hirta*, dry woods border and clearing, two stations. *R. hirta* var. *pulcherrima*,* disturbed ground, particularly in abandoned fields. *R. triloba*, bottomlands, streambanks, and woods borders. *Senecio viscosus*,* disturbed ground, probably more frequent in Pennsylvania than indicated in the *Atlas*.

*S. vulgaris,** vacant lot and disturbed shoreline, two stations. *Solidago altissima,* abandoned fields, thickets, and clearings. *S. bicolor* (glabrous, yellow-rayed variety), dry rocky slope, one station. *S. canadensis* var. *hargeri,* abandoned fields and clearings. *S. gigantea* Ait. var. *serotina* (Kuntze) Cronq. [var. *leiophylla*], wet thickets and streambanks. *S. nemoralis,* abandoned fields, open banks, and clearings. *S. patula,* wet woods, thickets, and bottomlands. *S. rugosa* var. *rugosa,* clearings, abandoned fields, and thickets. *S. rugosa* var. *aspera* and var. *villosa,* abandoned fields, one station. *S. squarrosa,* dry rocky banks, slopes, and ledges. *S. ulmifolia,* dry woods, thickets, and rocky slopes. *Sonchus oleraceus,** roadside bank, one station. *Tussilago farfara,** disturbed ground, particularly on road shoulders. *Vernonia noveboracensis,* bottomlands, streambanks, and wet clearings.

CONVOLVULACEAE: *Ipomoea pandurata,* dry open woods, thickets, and barrens.

CORNACEAE: *Cornus amomum* Mill. ssp. *obliqua* (Raf.) J. S. Wilson [*C. amomum* var. *schuetziana*], streambank thicket, one station. *C. rugosa,* rocky limestone slopes and ledges. *C. stolonifera,** wet thicket on abandoned strip mine, probably an escape, one station.

CRASSULACEAE: *Sedum telephium,** disturbed ground, particularly in ditches and bottomlands. *S. ternatum,* moist rocky woods, ledges, and bottomlands.

CRUCIFERAE (BRASSICACEAE): *Alliaria petiolata,** disturbed ground, particularly on roadbanks and in bottomlands. *Alyssum alyssoides,** disturbed ground, on dry limestone sites. *Arabidopsis thaliana,** disturbed ground, particularly on railroad embankments. *Arabis laevigata,* var. *burkii,* dry shaly woods. *A. lyrata,* limestone ledges and rocks. *A. patens,* rocky limestone woods and ledges. *Camelina microcarpa,** road shoulder, one station. *Cardamine douglassii,* moist wooded slope and streambank, two stations. *C. hirsuta,** moist disturbed ground. *C. parviflora* var. *arenicola,* dry shaly woods and banks, two stations. *Dentaria laciniata,* rich moist woods and streambanks. *Erysimum cheiranthoides,** marshy disturbed ground, two stations. *Lepidium densiflorum,** disturbed ground, particularly on road shoulders and railroad embankments. *Rorippa sylvestris,** disturbed ground, particularly on river banks. *Sisymbrium altissimum,** railroad embankment, one station. *Thlaspi arvense,** disturbed ground, particularly in cultivated fields.

CUSCUTACEAE: *Cuscuta gronovii,* streambanks, bottomlands, and moist thickets.

EBENACEAE: *Diospyros virginiana,* brushy railroad embankment, one station.

ELAEAGNACEAE: *Elaeagnus umbellata,** abandoned fields, clearings, and thickets.

ERICACEAE (s.l.): *Chamaedaphne calyculata,* one station, known only from a collection in 1855. *Chimaphila maculata,* dry acid woods and barrens. *Monotropa hypopithys,* open rocky woods, one station. *Vaccinium macrocarpon,* seepy ground on abandoned strip mine, one station. *V. stamineum,* dry acid woods, thickets, and rocky slopes.

EUPHORBIACEAE: *Acalypha virginica,* shaly abandoned field, one station. *Euphorbia cyparissias,** disturbed ground, particularly on road banks. *E. dentata,* rocky limestone bank, one station. *E. maculata* L. [*E. supina*], disturbed ground, particularly on road shoulders. *E. marginata,** road shoulder, one station. *E. peplus,** disturbed ground in alley, one station.

FAGACEAE: *Quercus bicolor,* wet woods, thickets, and bottomlands. *Q. ilicifolia,* dry acid thickets, rocky slopes, and barrens. *Q. muehlenbergii,* rocky limestone slopes and ledges. *Q. palustris,* wet woods, thickets, and bottomlands.

GENTIANACEAE: *Bartonia virginica,* acid clearings, barrens, and abandoned mine sites. *Gentiana andrewsii*, wet woods, thickets, and bottomlands. *G. clausa*, wet woods, thickets, and bottomlands.

GERANIACEAE: *Geranium carolinianum*, railroad embankment, one station. *G. columbinum*,* abandoned pasture over limestone, one station.

GUTTIFERAE (CLUSIACEAE): *Hypericum canadense*, seepy acid woods opening, one station, first record for the Ridge and Valley Province in south-central Pennsylvania. *H. gentianoides*, dry clearings, railroad embankments, and barrens. *Triadenum virginicum* var. *virginicum*, seepy acid clearing, one station. *T. virginicum* ssp. *fraseri* (Spach) J. M. Gillett [*T. virginicum* var. *fraseri*], seepy openings and shorelines.

HIPPOCASTANACEAE: *Aesculus hippocastanum*,* disturbed ground, particularly on streambanks, two stations.

HYDROPHYLLACEAE: *Hydrophyllum canadense*, wooded limestone slope, one station.

JUGLANDACEAE: *Carya tomentosa*, dry acid woods and barrens.

LABIATAE (LAMIACEAE): *Agastache nepetoides*, moist thickets and bottomlands. *A. scrophulariaefolia*, moist woods border, one station. *Cunila origanoides*, dry shale woods, one station. *Lamium amplexicaule*,* disturbed ground. *L. purpureum*,* disturbed ground. *Lycopus uniflorus*, shorelines, marshes, and wet places. *Mentha* × *gentilis*,* wet shoreline of pond, one station. *Monarda fistulosa*, brushy limestone thicket, one station. *M.* × *media*, seepy woods along stream, one station. *Physostegia virginiana*, rich seepy bottomland, one station. *Pycnanthemum muticum*, wet bottomland thicket, one station. *P. virginianum*, wet thickets and bottomlands. *Salvia lyrata*, rocky limestone bank, one station. *Stachys tenuifolia* var. *tenuifolia*, rich bottomland woods, two stations. *S. tenuifolia* var. *hispida*, wet ditch in bottomland, one station, widely scattered in Pennsylvania. *Trichostema brachiatum*, dry rocky abandoned quarry, one station. *T. dichotomum*, disturbed ground, particularly on railroad embankments.

LEGUMINOSAE (FABACEAE): *Cassia fasciculata*, railroad embankments, two stations. *C. nictitans*, railroad embankment, one station. *Coronilla varia*,* disturbed ground, particularly on road banks. *Desmodium canadense*, thicket along railroad embankment, one station. *D. dillenii* Darl. [*D. perplexum*], bottomlands, thickets, and disturbed ground. *D. glutinosum*, rocky woods and thickets. *D. marilandicum*, open shale bank, one station. *D. nudiflorum*, dry acid woods, thickets, and barrens. *Lathyrus latifolius*,* disturbed ground, particularly in abandoned fields. *Lespedeza capitata* var. *vulgaris*, dry clearings, two stations. *L. cuneata*,* dry clearing, one station. *L. intermedia*, dry clearings, thickets, and rocky banks. *L. procumbens*, dry open banks and clearings. *L. repens*, dry sandy clearings, two stations. *L. violacea*, abandoned limestone quarry, one station. *Lotus corniculatus*,* disturbed ground, particularly on road shoulders. *Trifolium aureum*,* disturbed ground, particularly on road shoulders and railroad embankments. *Vicia americana*, rocky limestone woods and thickets, two stations. *V. dasycarpa*,* roadside bank, one station. *V. villosa*,* roadside banks, two stations.

LIMNANTHACEAE: *Floerkea proserpinacoides*, rich bottomlands, streambanks, and springy woods.

LINACEAE: *Linum striatum*, marshes, wet thickets, and seepy places.

LYTHRACEAE: *Lythrum salicaria*,* seepy bottomlands, ditches, and disturbed ground.

MALVACEAE: *Abutilon theophrasti*,* disturbed ground, particularly in cultivated fields. *Hibiscus syriacus,** rocky river shoreline, one station. *H. trionum,** disturbed ground, particularly in cultivated fields.

MOLLUGINACEAE: *Mollugo verticillata,** disturbed ground, particularly on railroad embankments.

NYMPHAEACEAE: *Nuphar lutea* (L.) Sibth. & J. W. Smith ssp. *macrophylla* (Small) Beal [*N. advena* ssp. *macrophyllum*], slow streams, sinkholes, and marshes.

OLEACEAE: *Fraxinus americana* var. *biltmoreana,* brushy limestone slopes and ledges. *F. nigra,* wet woods, bottomlands, and streambanks. *F. pennsylvanica* var. *pennsylvanica,* streambanks and bottomlands. *Ligustrum amurense,** brushy bottomland, one station, a western range extension into central Pennsylvania. *L. obtusifolium,** thickets, bottomlands, and disturbed ground.

ONAGRACEAE: *Epilobium coloratum,* shorelines, marshes, and seepy places. *E. ciliatum* Raf. var. *ciliatum* [*E. glandulosum* var. *adenocaulon*], moist shoreline of reservoir, one station. *E. hirsutum,** open rocky road bank, one station, first record for the Ridge and Valley Province. *E. leptophyllum,* marshy ground along stream, one station. *Ludwigia alternifolia,* marshes, wet thickets, and bottomlands. *Oenothera biennis,* disturbed ground. *O. fruticosa* ssp. *glauca* (Michx.) Straley [*O. tetragona*], seepy clearings and ditches.

OXALIDACEAE: *Oxalis dillenii* Jacq. ssp. *dillenii* [*O. stricta*], fields, clearings, and disturbed ground. *O. grandis,* moist limestone woods, two stations. *O. violacea,* rocky wooded slopes and streambanks.

PAPAVERACEAE: *Papaver dubium,** disturbed ground, particularly on roadside banks, two stations.

PLANTAGINACEAE: *Plantago virginica,* abandoned railroad embankment, one station.

POLEMONIACEAE: *Polemonium reptans,* rich moist woods, two stations.

POLYGALACEAE: *Polygala sanguinea,* dry clearings, fields, and thickets.

POLYGONACEAE: *Polygonum amphibium* var. *emersum* Michx. [*P. coccineum*], seepy bottomland, one station. *P. arifolium* var. *pubescens,* wet woods and bottomlands. *P. caespitosum* var. *longisetum,** disturbed ground, particularly in open woods and bottomlands. *P. cuspidatum,** disturbed ground, particularly on abandoned mine sites and in thickets. *P. orientale,** open roadside bank, one station. *P. punctatum,* bottomlands, shorelines, and seepy places. *P. sachalinense,** railroad embankment, one station. *Rumex altissimus,** brushy railroad embankment, one station. *R. orbiculatus,* open seepy bottomland, one station, first record for the Ridge and Valley Province in central Pennsylvania.

PORTULACACEAE: *Portulaca oleracea,** disturbed ground, particularly in cultivated fields.

PRIMULACEACE: *Anagallis arvensis,** road shoulder, one station. *Lysimachia ciliata,* streambanks and bottomlands. *L.* × *producta,* brushy bottomland, one station, first record for the Ridge and Valley Province in south-central Pennsylvania. *L. terrestris,* wet bottomland thicket, one station.

RANUNCULACEAE: *Actaea rubra,* moist calcareous ledge, one station. *Anemone quinquefolia,* moist woods and streambanks. *Aquilegia vulgaris,** railroad embankment and road shoulder, two stations. *Caltha palustris,* bottomlands, streambanks, and wet places. *Consolida ambigua* (L.) Ball & Heyw. [*Delphinium ajacis*],* one station, reported by Henry and Buker (1958). *Coptis trifolia* var. *groenlandica* (Oeder) Fassett [*C. groenlandica*], seepy acid woods, two stations. *Hydrastis canadensis,* rich limestone woods, one station. *Ranunculus abortivus* var. *acrolasius,* moist woods border, one station. *R. ficaria,** moist wooded riverbank, two stations, first record for central Pennsylvania. *R. flabellaris,* submerged in sinkhole, one station. *R. hispidus* var. *hispidus,* dry limestone woods and rocky slopes. *R. repens,** disturbed ground, particularly on streambanks and in wet places. *Thalictrum coriaceum,* rocky limestone slopes and banks, two stations, a northern range extension in central Pennsylvania, apparently the northern limit for the species. *T. pubescens,* bottomlands, streambanks, and wet places. *T. revolutum,* dry open woods and barrens.

RHAMNACEAE: *Rhamnus frangula,** thickets and abandoned fields.

ROSACEAE: *Agrimonia gryposepala,* woods borders, thickets, and clearings. *A. parviflora,* bottomlands and wet thickets. *Amelanchier arborea,* dry woods, thickets, and rocky slopes. *A. humilis,* dry rocky slopes and ledges. *Aronia prunifolia,* acid thickets, woods borders, and barrens. *Aruncus dioicus,* moist rocky limestone slopes and ledges, two stations. *Crataegus crus-galli,* thickets, abandoned fields, and woods borders. *Duchesnea indica,** road shoulder, one station. *Fragaria vesca* var. *americana,* rocky limestone woods, one station. *Geum vernum,* disturbed limestone woods, one station. *G. virginianum,* dry bank and woods border, two stations. *Potentilla argentea,** road shoulder, one station. *Prunus americana,* woods borders and thickets. *Rosa blanda,** rocky bank of stream, one station. *R. canina,** fencerow and brushy limestone ledge, two stations. *R. multiflora,** abandoned fields, woods borders, and thickets. *R. palustris,* wet woods, thickets, and streambanks. *Rubus strigosus,* thickets, woods borders, and clearings. *Sanguisorba minor,** abandoned limestone quarry, one station. *Sorbaria sorbifolia,** abandoned mine site, one station. *Spiraea japonica,** thickets and woods borders, first record for central Pennsylvania. *S. latifolia,* shoreline of sinkhole, one station. *S. tomentosa,* wet thickets, ditches, and abandoned mine sites, first records for the Ridge and Valley Province in south-central Pennsylvania.

RUBIACEAE: *Cephalanthus occidentalis,* wet thickets, shorelines, and ditches. *Galium asprellum,* marshes, wet thickets, and bottomlands. *G. circaezans* var. *hypomalacum,* dry woods, rocky slopes, and banks. *G. concinnum,* rocky woods, streambanks, and barrens. *G. latifolium,* dry shaly woods, one station. *G. mollugo,** disturbed ground, particularly on road shoulders and in fields. *G. obtusum,* wet woods, two stations. *G. pilosum,* dry sandy clearings, two stations.

RUTACEAE: *Zanthoxylum americanum,* rocky limestone woods and thickets.

SALICACEAE: *Populus alba,** dry abandoned field, one station. *P.* × *jackii* Sarg. [*P.* × *gileadensis*],* thickets and abandoned fields. *Salix bebbiana,* shoreline of reservoir and wet thicket, two stations. *S. discolor* var. *latifolia,* wet thickets, two stations. *S. lucida* var. *lucida,* shoreline of reservoir and wet thicket, two stations. *S. lucida* var. *intonsa,* shoreline of reservoir, one station, in Pennsylvania chiefly in the glaciated northwestern section, reported from Bedford County (Henry 1978). *S. pentandra,** thicket in roadside ditch, one station. *S. rigida* var. *angustata,* bottomland thicket, one station. *S. tristis,* moist thicket along ditch, one station.

SAXIFRAGACEAE: *Heuchera pubescens,* dry rocky slopes and ledges. *Hydrangea arborescens* forma *grandiflora,** brushy border of words, probably an escape, one station, a western range extension into central Pennsylvania. *Ribes sativum* Syme [*R. rubrum*],* thickets, streambanks, and woods borders. *Saxifraga pensylvanica,* rich seepy woods, one station.

SCROPHULARIACEAE: *Agalinis tenuifolia,* dry woods, one station. *Aureolaria flava,* dry rocky woods, one station. *A. pedicularia,* open rocky slope, one station. *A. virginica,* dry open woods and barrens. *Castilleja coccinea,* one station, reported by

Henry and Buker (1963). *Chaenorrhinum minus,** disturbed ground, particularly on road shoulders. *Chelone glabra* var. *glabra* and var. *elatior,* streambanks, bottomlands, and seepy places. *Kicksia elatine,** open rocky bank and road shoulder, two stations, a western range extension into central Pennsylvania. *Lindernia dubia,* shorelines, bottomlands, and seepy places. *Mimulus alatus,* marshy bottomland, one station. *Penstemon canescens,* dry rocky slope, one station. *Scrophularia lanceolata,* clearings, open banks, and thickets. *Veronica hederifolia,** moist roadside bank and bottomland, two stations, first records for the Ridge and Valley Province in central Pennsylvania. *V. persica,** disturbed ground, particularly in cultivated fields. *Veronicastrum virginicum,* dry brushy slope, one station.

SOLANACEAE: *Datura stramonium,** moist disturbed ground, particularly in barnyards. *Lycium halimifolium,** brushy bottomland, one station. *Lycopersicon esculentum,** gravelly shoreline of river, one station. *Solanum carolinense,* abandoned fields, clearings, and disturbed ground. *S. nigrum,* rocky slopes, streambanks, and disturbed ground.

STAPHYLEACEAE: *Staphylea trifolia,* moist limestone woods and ledges.

THYMELAEACEAE: *Dirca palustris,* streambanks, rocky limestone slopes and ledges.

ULMACEAE: *Ulmus pumila,** brushy abandoned field, one station.

UMBELLIFERAE (APIACEAE): *Angelica atropurpurea,* shorelines, marshes, and bottomlands. *Chaerophyllum procumbens,* rich wooded bottomland, one station. *Conium maculatum,** moist disturbed ground. *Sium suave,* seepy bottomland, one station. *Thaspium barbinode,* rocky woods, ledges, and brushy slopes. *Zizia aurea,* streambanks and bottomlands.

URTICACEAE: *Parietaria pensylvanica,* open woods, rocky slopes, and disturbed ground. *Urtica dioica* var. *dioica,** moist disturbed bottomland, one station. *U. dioica* ssp. *gracilis* (Ait.) Seland. [*U. procera*], moist bottomlands, streambanks, and disturbed ground.

VALERIANACEAE: *Valerianella locusta* (L.) Laterr. [*V. olitoria*],* moist limestone banks and disturbed ground.

VIOLACEAE: *Hybanthus concolor,* moist limestone woods and ledges. *Viola arvensis,** disturbed ground, two stations. *V. lanceolata,* sandy shorelines, ditches, and seepy places. *V. pallens,* cool moist woods, one station. *V. pedata,* dry open woods, one station. *V. pensylvanica,* rich moist woods and streambanks. *V. sororia* forma *albiflora* (cv. *priceana*), railroad embankment, one station. *V. striata,* bottomlands, streambanks, and moist woods. *V. triloba,* dry woods, banks, and rocky slopes.

VITACEAE: *Parthenocissus vitacea,* brushy abandoned field, one station. *Vitis labrusca,* streambanks, bottomlands, and wet thickets.

MAGNOLIOPHYTA–LILIOPSIDA

ALISMATACEAE: *Sagittaria latifolia* var. *pubescens,* open marshy bottomland, one station.

AMARYLLIDACEAE: *Narcissus pseudonarcissus,** moist disturbed ground.

ARACEAE: *Acorus americanus* (Raf.) Raf. [*A. calamus*], marshes, ditches, and open springy ground. *Symplocarpus foetidus,* bottomlands, seepy woods, and streambanks.

COMMELINACEAE: *Commelina communis* var. *communis* and var. *ludens,** disturbed ground.

CYPERACEAE: *Carex abscondita,* one station, reported by Henry and Buker (1963). *C. aestivalis,* dry acid woods and streambanks. *C. aggregata,* rich wooded bottomland, one station. *C, annectans* var. *annectans,* wet thicket and marsh, two stations. *C.*

bromoides, wet woods and bottomlands. *C. canescens*, marshy ground along stream, one station. *C. cephalantha*, marshy ground along stream, one station. *C. comosa*, marshes and wet bottomlands. *C. crinita*, seepy woods and ditches, two stations. *C. cristatella*, streambanks, shorelines, and marshes. *C. davisii*, rocky limestone woods, two stations. *C. debilis* var. *pubera*, open acid woods, one station. *C. eburnea*, seepy limestone ledge, one station, a western range extension into central Pennsylvania, previously known only from Lehigh and Northampton counties. *C. festucacea*, moist wooded bottomland, one station. *C. folliculata*, seepy ground in abandoned strip mine, one station. *C. grayi* var. *grayi* and var. *hispidula*, wooded bottomlands and streambanks. *C. hirtifolia*, open rocky woods, two stations. *C. hystericina*, marshes and wet thickets, two stations. *C. lacustris*, wet woods, one station. *C. laevivaginata*, marshes and wet bottomlands. *C. leptalea*, wet woods, thickets, and streambanks. *C. leptonervia*, rich woods and streambanks. *C. lupulina*, shorelines, bottomlands, and seepy places. *C. muhlenbergii*, dry sandy clearing, one station. *C. pedunculata*, rocky limestone woods, one station. *C. pensylvanica* var. *lucorum* (Willd.) Fern. [*C. p.* var. *distans*], dry acid woods, one station. *C. prasina*, seepy woods, thickets, and streambanks. *C. radiata*, moist rocky woods, one station. *C. schweinitzii*, marshy ground along stream, one station. *C. stipata*, marshes, shorelines, and wet bottomlands. *C. stricta* var. *stricta*, marsh and wet woods, two stations. *C. stricta* var. *strictior* (Dewey) Carey [*C. strictior*], wet woods, one station. *C. trisperma*, wet woods, one station. *C. umbellata*, dry banks, clearings, and open woods. *C. vesicaria*, shoreline of sinkhole, one station. *C. willdenowii*, dry woods and rocky slopes. *Cyperus esculentus*, disturbed ground, particularly in cultivated fields. *Dulichium arundinaceum*, shorelines, wet bottomlands, and marshes. *Eleocharis acicularis*, ditches, shorelines, and dried-up water holes. *E. intermedia*, open seepy ground along stream, one station, a western range extension into central Pennsylvania. *E. obtusa*, shorelines, marshes, and ditches. *E. smallii*, marsh and shoreline of reservoir, two stations. *Scirpus pendulus*, marshy bottomland, one station. *S. pungens* Vahl [*S. americanus*], wet bottomland thicket, one station. *S. verecundus*, dry rocky slope, one station.

GRAMINEAE (POACEAE): *Agrostis palustris*,* seepy pond shoreline and submerged in river, two stations. *A. tenuis*,* road shoulder, one station. *Andropogon gerardii*, dry limestone slopes, rocky banks, and barrens. *A. glomeratus*, seepy opening on abandoned strip mine, one station. *A. virginicus*, dry clearings, abandoned fields, and barrens. *Aristida oligantha*, railroad embankments. *Avena sativa*,* road shoulder, one station. *Bouteloua curtipendula*, dry limestone ledge, one station. *Brachyelytrum erectum* var. *septentrionale*, acid woods, thickets, and streambanks. *Bromus ciliatus* var. *intonsus*, woods opening, one station. *B. japonicus* var. *porrrectus*,* disturbed ground, particularly on road shoulders. *Calamagrostis cinnoides*, dry sandy clearing, one station. *C. epigejos*,* railroad embankment, where well-established, one station, known previously only from Centre and Montgomery counties. *C. porteri*, dry acid woods and barrens. *Cinna arundinacea*, bottomlands, streambanks, and moist woods. *Danthonia compressa*, dry woods, clearings, and rocky slopes. *Deschampsia flexuosa*, dry woods and clearings, particularly on shale. *Dichanthelium boscii* (Poir.) Gould & Clark [*Panicum boscii* var. *molle*], dry woods, rocky slopes, and barrens. *D. depauperatum* (Muhl.) Gould [*Panicum depauperatum* var. *psilophyllum*], dry woods, clearings, and barrens. *D. sabulorum* var. *thinium* (Hitchc. & Chase) Gould & Clark [*Panicum columbianum*], dry sandy clearing, one station. *D. sphaerocarpon* var. *isophyllum* (Scribn.) Gould & Clark [*Panicum microcarpon, P. polyanthes*], marshy bottomlands, streambanks, seepy ground, and sandy woods openings. *Echinochloa muri-*

cata (Beauv.) Fern. [*E. pungens*], shorelines, bottomlands, and disturbed ground. *Eleusine indica,** disturbed ground, particularly on road shoulders. *Elymus canadensis,* railroad embankment, one station. *E. villosus,* streambanks and bottomlands. *Eragrostis capillaris,* disturbed ground, particularly on road shoulders and railroad embankments. *E. frankii,* ditch along railroad and abandoned quarry, two stations. *E. hypnoides,* shorelines, ditches, and dried-up water holes. *E. minor* Host [*E. poaeoides*], disturbed ground, particularly on railroad embankments. *Festuca rubra,** dry clearings, woods, and disturbed ground. *Glyceria acutiflora,* shoreline of sinkhole, one station. *G. canadensis,* marshes and wet thickets. *G. septentrionalis,* wet ditch in bottomland, one station. *Hordeum jubatum,* road shoulder, one station. *Lolium perenne* L. var. *perenne** and var. *multiflorum* (Lam.) Parn. [*L. multiflorum*],* disturbed ground, two stations. *Melica nitens,* brushy limestone ledge, one station. *Milium effusum,* cool moist woods, two stations. *Muhlenbergia mexicana,* wet thickets, rocky slopes, and disturbed ground. *M. sylvatica,* wet woods, one station. *M. tenuiflora,* rocky woods, slopes, and streambanks. *Oryzopsis asperifolia,* dry rocky slopes and clearings. *Panicum capillare* var. *capillare,* disturbed ground, particularly on railroad embankments. *P. verrucosum,* railroad embankments, two stations. *P. virgatum,* clearings and disturbed ground. *Phalaris arundinacea* forma *variegata,* roadside ditch, possibly an escape, one station. *Phragmites australis,* disturbed ground, on or near railroad embankments, forms large colonies at several sites in the county. *Poa languida,* dry acid woods and barrens. *P. palustris,* open seepy bottomlands, two stations. *P. saltuensis,* cool moist woods and streambanks. *P. sylvestris,* moist wooded slopes and bottomlands. *Puccinellia pallida* (Torr.) Clausen [*Glyceria pallida*], shoreline of sinkhole, one station. *Schizachne purpurascens,* moist wooded slopes and ledges. *Secale cereale,** road shoulder, one station. *Sorghastrum nutans,* rocky limestone slopes and ledges. *Spartina pectinata,* wet ditch in bottomland, one station. *Sporobolus asper,* abandoned limestone quarry and road shoulder, two stations. *S. neglectus,* railroad embankments, two stations. *Trisetum pensylvanicum,* marshes and springy clearings. *Triticum aestivum,** disturbed ground, particularly on railroad embankments.

IRIDACEAE: *Iris pseudacorus,** shoreline of reservoir, one station. *I. versicolor,* marshy bottomland and streambank, two stations.

JUNCACEAE: *Juncus articulatus,* wet thicket and clearing, two stations. *J. biflorus,* marshy bottomland, one station. *J. bufonius,* open seepy streambank, one station. *J. canadensis,* wet acid clearing, one station. *J. debilis,* sandy shoreline of abandoned clay pit, one station. *J. effusus* var. *pylaei,* seepy streambank, one station. *J. nodosus,* marshy ground along stream, one station. *J. subcaudatus,* shorelines, ditches, and seepy places. *J. tenuis* forma *anthelatus,* disturbed ground. *J. torreyi,* seepy disturbed ground, associated with abandoned mine sites or railroad embankments, widely scattered in Pennsylvania.

LEMNACEAE: *Lemna turionifera* Landolt, one station, known only from a collection in 1852, not included in the *Atlas.*

LILIACEAE: *Convallaria majalis,** disturbed wooded slope, one station. *Hemerocallis lilioasphodelus* L. [*H. flava*],* railroad embankment and roadside bank, two stations, first records for the Ridge and Valley Province in central Pennsylvania. *Hosta ventricosa,** moist limestone roadbank, one station. *Lilium canadense,* marsh and wet thicket, two stations. *Melanthium latifolium* Desv. [*M. hybridum*], dry open woods, thickets and barrens. *Muscari botryoides,** moist bottomlands and streambanks. *Poly-*

gonatum commutatum, rocky limestone woods border, one station. *Trillium erectum* forma *albiflorum* Hoffm. [var. *album*] and forma *luteum,* rich moist woods and streambanks. *Uvularia sessilifolia,* woods, thickets, and streambanks. *Veratrum viride,* streambanks, wet woods, and seepy places. *Yucca filamentosa* L. var. *smalliana* (Fern.) Ahles [*Y. smalliana*],* railroad embankment and abandoned field, two stations.

NAJADACEAE: *Najas marina* L., submerged in abandoned limestone quarry, one station; new state record, a specimen was examined by R. R. Haynes of the University of Alabama.

ORCHIDACEAE: *Corallorrhiza trifida* var. *verna,* seepy woods, one station. *Cypripedium acaule,* dry acid woods and barrens. *Epipactis helleborine,** disturbed ground, particularly on road shoulders and rocky banks. *Galearis spectabilis,* rich moist woods. *Goodyera pubescens,* moist rocky woods, one station. *Platanthera clavellata,* streambanks, ditches, and seepy places. *P. lacera,* moist brushy bottomland, one station. *Spiranthes cernua,* shorelines, ditches, and seepy places. *S. lucida,* open muddy shoreline, one station.

POTAMOGETONACEAE: *Potamogeton diversifolius,* submerged in pond, one station. *P. epihydrus* var. *nuttallii,* submerged in stream and reservoir, two stations.

SPARGANIACEAE: *Sparganium chlorocarpum* var. *acaule,* open shoreline of reservoir, one station. *S. emersum* var. *angustifolium* (Michx.) R. L. Taylor & MacBryde [*S. angustifolium*], submerged in shallow water of reservoir, one station, a southwestern range extension into central Pennsylvania, first record south of glacial boundary.

TYPHACEAE: *Typha angustifolia,* marshy bottomland and shoreline, two stations. *T. latifolia* forma *ambigua,* shoreline of pond, one station.

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Opinions of Rafinesque Expressed by His American Botanical Contemporaries[1]

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Constantine Samuel Rafinesque-Schmaltz (1783–1840) was without doubt North America's most versatile and controversial naturalist. Active during the first half of the nineteenth century, he was an eccentric and erratic individual of remarkable mental ability and indefatigible energy whose investigations in all fields of natural history resulted in over 1000 published titles. These works generated much interest and came under continuing scrutiny, evaluation, and re-evaluation from his contemporaries and their immediate successors. Rafinesque's *Bibliotheca* totaled 370 articles as reported in the combined publications of Fitzpatrick (1911), Merrill (1942, 1949), and Stuckey and Roberts (1974), and 540 titles as listed in the revised and enlarged *Fitzpatrick's Rafinesque* of Boewe (1982). These publications attest to the resurgence of interest in Rafinesque's life and scientific work. For his life, perhaps the most comprehensive and authoritative treatments are his own *Life of Travels* (1836) and those of Call (1895), Fitzpatrick (1911), Pennell (1942), and the "Introduction" in Merrill (1949), all based on original sources. Two popular accounts of Rafinesque's life and work are those by Hagen (1947) and Robbins (1985).

As a botanist, Rafinesque named and described as new to science some 2700 genera, approximately 6700 species, and numerous varieties of plants, from all parts of the world. From this activity alone, his imprint on world-wide descriptive botany is inevitably lasting. Because of modern rules of botanical nomenclature, every botanist who now undertakes systematic studies of those plants about which Rafinesque wrote must take into consideration the plant names he proposed. Although his publications drew much attention, his plant names were largely ignored by Rafinesque's contemporaries and their successors, who often thought his botanical publications worthless, but consideration of these names became more necessary as the *Code of Botanical Nomenclature* was refined during the first half of the twentieth century. During this period a few North American botanists paved the way for a better understanding of the taxonomy and nomenclature proposed by Rafinesque. Among these contributors were Francis W. Pennell (1921, 1922), who studied his Scrophulariaceae; Merritt L. Fernald (1932, 1944, 1946), who discussed some of his taxa from eastern North America; Elmer D. Merrill (1949), who indexed all of his known proposed names, provided their original literature citations, and gave, where possible, their modern equivalents; Lloyd Shinners (1951, 1957, 1962), who re-evaluated several species of North American plants; and Ronald L. Stuckey (1971a,b), who in tracing the history of Rafinesque's herbarium, provided information on specimens that have survived and on the availability of the few extant types.

Little study has focused on the reasons for which Rafinesque and his botanical work were largely rejected by his contemporaries, although Keir B. Sterling (1978) took this approach in his "Introduction" to the three reprinted accounts of Rafinesque's life. My intention in this paper is to provide a view of Rafinesque and his botanical work derived from statements by those botanists who knew him personally or who had some knowledge of his work. These private comments on his character and work have survived in the many letters that were exchanged among the various botanists active in eastern North America during the first half of the nineteenth century. Although a few of these comments have appeared in scattered publications, this paper represents a first effort toward assembling them in one place.

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[1] Presented at the Bicentennial Celebration of the birth of Constantine Samuel Rafinesque (1783–1983), held at Transylvania University, Lexington, Kentucky, 21 October 1983. An account of the symposium has been published by Rafinesque, Rafinesque, and Reynaud (1984).

THE NORTH AMERICAN BOTANICAL SCENE, 1800–1840

Prior to 1840, botanical activity in North America centered in Philadelphia and the surrounding area, where several individuals began to compile comprehensive floras of the continent. Benjamin Smith Barton (1766–1815), professor of materia medica, natural history, and botany in the University of Pennsylvania and author of the first North American textbook of botany, projected such a flora, but himself did little toward its preparation. To aid in this effort, Barton in 1807 hired Frederick Pursh (1774–1820), a German-born horticulturist, and following Pursh's early defection, Barton in 1808 engaged the services of Thomas Nuttall (1786–1859), an English naturalist. Each employee worked more diligently for himself than for Barton, and each published his own flora, the first being Pursh's *Flora Americae Septentrionalis* (1814) and the second Nuttall's *The Genera of North American Plants . . .* (1818).

Seventy miles west of Philadelphia in Lancaster, Pennsylvania, the Lutheran minister Gotthilf Henry Ernst Muhlenberg (1753–1815) prepared a *Flora Lancastriensis* (1785) and *Index Florae Lancastriensis* (1793), based on herbarium specimens from the area. He exchanged specimens and information with other North American botanists, principally Stephen Elliott (1771–1830) of Charleston, South Carolina, who wrote a remarkable *Sketch of the Botany of South-Carolina and Georgia* (1816–1824), and Dr. William Baldwin (1779–1819) of Wilmington, Delaware, and later of Georgia. Baldwin, an ardent botanist, early studied the flora of the southeastern United States and became an authority on sedges, but because of ill health and an early death, left most of his work in manuscript, some of which was published by later botanists.

Muhlenberg held the strong conviction that knowledge of the entire North American flora could best be assembled through the production of local floras by botanists working in their own neighborhoods. Toward that end, in addition to his own local flora, he published a *Catalogus Plantarum Americae Septentrionalis . . .* (1813) derived from information sent him by his correspondents. In the years following his death, Muhlenberg's idea had support from several botanists. Foremost among them in the early 1820s was the Rev. Lewis David von Schweinitz (1780–1834), clergyman of the Moravian Church at Bethlehem, Pennsylvania, whose work in phanerogamic botany consisted of monographic treatments, a local flora, descriptions of new species, and a 357-page unpublished manuscript, *Synopsis Plantarum Americanum* (undated), containing the names, descriptions, and habitat notes on the then known flowering plants and ferns of the continent. Others who shared similar viewpoints were two of Barton's students, William Darlington, M.D. (1782–1863) of West Chester, Pennsylvania, who wrote *Florula Cestrica* (1826) and *Flora Cestrica* (1837), and Charles Wilkins Short, M.D. (1794–1863), from Lexington and later Louisville, Kentucky, who prepared a *Florula Lexingtoniensis . . .* (1828–1829), and with his colleagues, Robert

Peter, M.D. (1805–1894), and Henry A. Griswold (d. 1873), compiled *A Catalogue of the Native Phaenogamous Plants, and Ferns of Kentucky* (1833), followed by four supplements (1834–1840). Farther west at St. Louis, the German-born physician George Engelmann (1809–1884) took up the study of botany and was its principal western figure from the 1840s through the 1860s.

Meanwhile, Amos Eaton (1776–1842), pioneer educator in natural history and senior professor in the Rensselaer School at Troy, New York, popularized the study of botany through his *Manual of Botany for the Northern States* (1817). It saw eight editions (1817–1840), the last coauthored with one of his students, John Wright (1811–1846). Eaton trained many students who subsequently contributed to the knowledge of floristic botany in eastern North America. Among them were Lewis C. Beck (1798–1853) of New York, Douglass Houghton (1809–1845) of Michigan, Robert Peter (1805–1894) in Kentucky, and John L. Riddell (1807–1865) in Ohio and later Louisiana. Eaton's foremost student was John Torrey (1796–1873), professor of chemistry at several schools in and near New York City. Torrey first learned botany from Eaton, while from 1811 to 1815, the latter was in the prison where Torrey's father was an officer. Torrey was also greatly aided in his early endeavors through letters from and personal contacts with Schweinitz. Torrey published a *Catalogue of Plants . . . within Thirty Miles of the City of New York* (1819) and one volume of a *Flora of the Northern and Middle Sections of the United States* (1824), a work which began to assemble all of the known descriptive information on American floristic botany. To aid him in these floristic studies, Torrey in 1835 hired a young science teacher, Asa Gray (1810–1888), who had completed his medical education four years earlier but was not particularly interested in making a career of medicine. Gray, who was to become North America's foremost botanist of the latter half of the nineteenth century, joined in partnership with Torrey, and together they prepared a definitive and documented *Flora of North America* (1838–1843). A monumental work of seven parts in two volumes, it served as an authoritative and enduring study of the North American flora, even though it left untreated the Monocotyledoneae and several families of Dicotyledoneae.

RAFINESQUE'S ENTRY INTO AMERICAN BOTANY

To this North American botanical fraternity came a 19-year-old immigrant naturalist, Constantine Samuel Rafinesque, born in Galata, a suburb of Constantinople. As described in his *Life of Travels* (1836), Rafinesque spent his early youth roaming southern Europe studying botany and other sciences, before arriving in Philadelphia on 18 April 1802, where he proclaimed that everything he saw was new. During the next three years Rafinesque botanized as far west as the Allegheny Mountains of eastern Pennsylvania and as far south as Virginia. While traveling in America he visited and became acquainted with "all the botanists"—including Barton, Darlington, Muhlenberg, and Pursh—by whom he was generally well received. Early in 1805, he returned to Europe with an herbarium of 2400 species and 10,000 specimens which served as a basis for his later botanical publications. Headquartered in Palermo, Sicily, for the next 10 years, he prepared botanical notes which appeared in Barton's *Philadelphia Medical and Physical Journal* (1805), Samuel L. Mitchill's *The Medical Repository* at New York (1806–1811), Desvaux's *Journal de Botanique* (1808–1814), among other publications.

During his return voyage to North America in November 1815, Rafinesque was shipwrecked off the coast of Connecticut and lost all of his possessions, including his herbarium of American and European plants. Sympathetic friends in New York City gave him assistance, and he began to rebuild his career. The following spring he commenced with zeal to prepare another herbarium. For the next three years he traveled principally in New York and New England and again became acquainted with the botanists he met en route, including Beck and Torrey in New York and Nuttall in Philadelphia.

In 1818, Rafinesque began his travels in the Western Country, and explored parts of Ohio, Indiana, Illinois, Kentucky, and Tennessee. Four times he crossed the Allegheny Mountains on foot from the east, but he settled in Lexington, Kentucky from 1819 to 1826, where at Transylvania University he was appointed to the first professorship of botany, natural history, and modern languages west of the Alleghenies. While there he met twice with the principal botanist of Kentucky, Dr. Charles W. Short. Their first meeting took place in 1821 in Lexington, when they botanized together on a trip to North Bend, Ohio, on the Ohio River. Here they visited with Short's older brother, John Cleves Short, a lawyer, and their uncle, General and later President William Henry Harrison. The second meeting took place in 1823 at Short's home in Hopkinsville, where they spent several days studying the plants of the barrens of western Kentucky. Much of the botanical information they exchanged is preserved in 12 letters from Rafinesque to Short. Eleven were published by Perkins (1938), with texts so poorly transcribed that Boewe (1980) was compelled to correct them; the twelfth was added by Davies (1949). One letter from Short to Rafinesque is known to survive (Boewe 1961).

Because of "the influence of the foes of sciences" in Transylvania University, Rafinesque became dissatisfied and left his position in the spring of 1826. He returned to Philadelphia via a northern route through Ohio to Sandusky on Lake Erie and eastward through New York, where he met Professor Eaton and his students at Rochester, and his friend, Dr. Torrey, at the Military Academy on the Hudson River. Thereafter he made his home in Philadelphia, from which he made numerous short botanical excursions into eastern Pennsylvania, the surrounding states, and New England. He visited Schweinitz in Bethlehem in 1828, and renewed friendships several times with Beck, Eaton, and Torrey in New York during the 1830s.

In addition to naming and describing thousands of new taxa, Rafinesque, as a contributor to floristic and descriptive botany, wrote local floras, published generic monographs, and prepared critical reviews of many of the floras written by his contemporaries. In his latter years, he published at his own expense floras of continental scope, among them his *Medical Flora* (1828, 1830), *New Flora and Botany of North America* (1836[–1838]), *Flora Telluriana* ("1836" [1837–1838]), *Alsographia Americana* (1838), *Sylva Telluriana* (1838), and *Autikon Botanikon* (1840). While North American botanists considered Rafinesque's early botanical publications credible, the contributions that appeared after his return to America in 1815, and especially those published after he returned to Philadelphia from Lexington in 1826, were severely questioned and criticized by his contemporaries.

Opinions of Rafinesque Expressed by American Botanists

Muhlenberg and Baldwin's Opinions. Among the first to criticize Rafinesque's botanical work was the conservative and scholarly Henry Muhlenberg, who wrote to Stephen Elliott on 16 June 1809, concerning Rafinesque's *Prospectus . . . on North-American Botany; the First on the New Genera and Species of Plants Discovered by Himself* (1808).

> Have you seen what Mr. Rafinesque Schmal[t]z had printed in the New York Medical Repository[2] and what he promises to publish hereafter? He makes a wonderful change and havoc amongst our plants and will do much harm if he keeps his promise. I know him personally and find a great number of my plants, which I gave him, superficially described without mentioning a word from whence he had them. Very often he makes a genus where hardly a species can be made, and where his specimen was quite imperfect. There is a medium in everything. In botany the *festina lente* is very necessary.

Muhlenberg wanted a cautious approach in the delimitation of taxa, and his comment sounded the warning that botanists should be ready to evaluate critically Rafinesque's proposals of new taxa. But Rafinesque did not hesitate to express his views; he was a nonconformist, uncontrolled and uncontrollable.

The botanical correspondence between Muhlenberg and William Baldwin and between William Darlington and Baldwin was published by Darlington in *Reliquiae Baldwinianae* (1843), and contains a few comments about Rafinesque. On 7 January 1811 Muhlenberg expressed some concern about Rafinesque's new plants described from the state of Delaware: "Mr. Rafinesque was rather too quick in naming plants, and may have been mistaken in some names." A week later, on 14 January, Baldwin replied:

> I hope I shall be able to send some of the plants you have mentioned, as discovered and named by Mr. Rafinesque; and perhaps some others that escaped his notice. This indefatigable Botanist has, perhaps, independent of his new discoveries, unnecessarily changed some of the *Linnaean names*.

Following Muhlenberg's death in 1815, Baldwin's principal correspondent was his very close friend, Darlington, to whom on 17 September 1818 he made the following statement concerning Rafinesque's *Florula Ludoviciana* (1817):

> It is a shocking production, to come from one who has placed himself at the head of the botanical profession in our country,—and who finds fault with, and criticises all his predecessors and contemporaries.

Baldwin's comment might indicate that American botanists were in no mood to contend with the disruptions of this foreigner. Subsequently, Rafinesque began to have difficulty getting his manuscripts accepted for publication in America, as Baldwin related to Darlington on 4 February 1819:

> I had an opportunity, for the first time, of attending a meeting of the Academy of Natural Sciences. Two communications, on New Genera, from the redoubtable pen of Rafinesque, member of ten thousand learned societies, had been examined by a committee,—and rejected, as unworthy of publication!
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> I am truly glad . . . that they have sufficient independence to reject the wild effusions of a *literary madman*. He is now in the city; but as he is *huffed* at the Academy, I had not the honor of seeing him there, and did not think it worth while to seek after him.

This event occurred in the same year that Benjamin Silliman (1779–1864), editor of the *American Journal of Science*, "became alarmed by a flood of communications . . . by C. S. Rafinesque, and being warned, both at home and abroad, against his claims. . . ," Silliman (1841) returned his manuscripts and would henceforth refuse to publish Rafinesque's papers. Silliman wrote further: ". . . he alone would have filled the Journal, had he been permitted to proceed." Because Rafinesque's manuscripts were suppressed by many North American scientific journals, he established his own journals and published his work privately. With reference to one of these attempts,

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[2] Rafinesque's six papers in *The Medical Repository*, published in New York, covered various topics in natural history and appeared in volumes 2, 3, and 5 in 1804, 1806, and 1808, respectively. Complete citations of these papers are given as items 3, 5, 6, 8, 9, and 10 in the "Bibliography of C. S. Rafinesque" (Fitzpatrick 1911; Boewe 1982).

Lewis David von Schweinitz gave his opinion to John Torrey in a letter of 12 April 1832:

> I wonder whether you have seen the most extraordinary & impertinent publication which Rafinesque has just issued—on every possible subject, under the title of Atlantic Journal [Rafinesque (1832)]. He is doubtless a man of immense knowledge—as badly digested as may be & crack-brained I am sure. His short reviews of 23 recent works—among which your ed. of Lindley [Torrey (1831)] is likewise paraded—are truly comical.

EATON'S OPINIONS EXPRESSED TO TORREY. Amos Eaton enjoyed the friendship of many scientists, but no scientific confidant was closer than John Torrey. As described by McAllister (1941, p. 213), Eaton guided Torrey over many a pitfall of youth and inexperience, while Torrey was sympathetic, loyal, and always willing to assist Eaton in the search for scientific knowledge. Eaton, who did not meet Rafinesque until 1826, described some of his idiosyncrasies to Torrey on 5 October 1817:

> I am glad Mr. Rafinesque has not set you all wild. Why can not he give up that foolish European foolery, which leads him to treat Americans like half-taught school boys? He may be assured, he will never succeed in this way . . . His new names with which he is overwhelming the science will meet with universal contempt. Cannot some friend induce him to return to sober reason, and thus make himself highly useful and much esteemed?

On 24 March of the following year, Eaton wrote:

> What is the matter with Rafinesque? In the March number of the New York Monthly Magazine[3] we are not amused with the usual quantity of the new names and wonderful acts of Mr. R. written by himself. Now do appoint some member of your society to write half a dozen pages every month in praise of Rafinesque. Then I presume he would be willing to devote part of his time to some other subject.

Eaton added in sympathy and ultimate frustration:

> I have defended him in New England, until I am ashamed to mention his name. His name is absolutely becoming a substitute for egotism. Even the ladies here, often adorn their witticisms with the name of Rafinesque, applied in the same. They talk of the science of Rafinesquism; meaning the most foolsome and disgusting manner of speaking in one's own praise.

Eaton's opinion of Rafinesque changed somewhat after they met eight years later, when Eaton was botanizing with his students along the Erie Canal, and Rafinesque was returning for the last time to Philadelphia from Lexington (Clinton 1910; Rezneck 1959). Of this encounter, Eaton wrote to his wife on 3 April 1826:

> When we were at Rochester, the celebrated Rafinesque overtook us. He joined our party and is now with us, and is to continue on to Troy. I shall invite him to our house. He is a curious Frenchman. I am much pleased with him; though he has many queer notions.

When Rafinesque proposed giving lectures in Troy in 1835, Eaton publicly praised him, while referring to his "supposed scientific heresies," as noted from a local newspaper, *The Troy Whig* (McAllister 1941, p. 257).

> Even those who are disposed to pronounce Mr. R. an extravagant enthusiast, all agree, that he is a scholar of the first order; of vast reading and great classic learning. His nice discriminating talents have never been questioned . . . "Shades of variety" as evidence of specific differences comprise all his supposed scientific heresies.

TORREY'S OPINIONS EXPRESSED TO EATON, DARLINGTON, AND SHORT. John Torrey was perhaps Rafinesque's closest botanical friend, and their relationship lasted nearly

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[3] The journal referred to is *The American Monthly Magazine and Critical Review* published in New York. The March issue contains a review of Jacob Bigelow's *Florula Bostoniensis* (1814), and is item number 265 in the "Bibliography of C. S. Rafinesque" (Fitzpatrick 1911; Boewe 1982).

25 years. Torrey often praised Rafinesque, but over all his opinions appear inconsistent. Writing to Eaton in 1817, he singled out Rafinesque as the best naturalist he knew, but cautioned against his finding so many undescribed plants.

> The circular address of Rafinesque [(1816)] which I send you will give you some idea of his character. He is the best *naturalist* I am acquainted with, but he is too fond of novelty. He finds too many new things. All is new! new! He has an opinion that there are no plants common to Europe and America.

In reply to Eaton's letter of 5 October 1817, Torrey wrote on 5 January 1818:

> Raf. certainly deserves to be ridiculed—his vanity is absolutely intolerable . . . Is it not preposterous for a man to pretend to write a flora of a country he never even visited. If Raf. was to travel in Louisiana himself, & the very same ground that Robin did he could not find the plants he has described [Rafinesque (1817)]—I shall say no more about it, but let you judge for yourself.

In a later letter of 12 March 1818 to Eaton, Torrey wrote sarcastically of the *Florula Ludoviciana* (1817):

> This work is the most curious medley I ever saw. The author without ever being in the country whose plants he describes, has discovered 50 or 60 new species . . . I expect he will soon issue proposals for publishing the botany of the moon with figures of all the new species!

On 16 April 1818, Torrey wrote Eaton:

> Rafinesque has just started on a three-months expedition. He goes through Philadelphia to Pittsburg, and intends to explore the Borders of the Lakes before he returns. You may imagine how many new discoveries he will make. He was almost Crazy with anticipation before he left here.

In this same letter, Torrey also gave his advice, which Eaton had sought earlier, concerning the naming of a species in Rafinesque's new genus *Clintonia*.

> You ask me whether you shall adopt the Genus Clintonia. Although I think that the plant which has been dedicated to Mr. Clinton, should not be called either Dracenia or Convallaria, yet I do not think that Clinton's attainments in Botany at all warrant its bearing his name. Nor would I adopt it if it did,—merely because it emanates from Mr. Rafinesque, for I should be afraid it would ruin my work.

Another remark about Rafinesque's character appears in Torrey's letter of 18 May 1819 to Eaton:

> The public is so much prejudiced against Mr. R. that whatever comes from his pen, let it be ever so good, is treated with greatest ridicule. It is very unfortunate for this laborious naturalist to have obtained such a character—a character which I am sure he does not deserve.

At times Torrey must have become disgusted with Rafinesque's persistence in discussing "perpetual mutability" and other matters during overextended visits. To William Darlington, on 12 August 1831, he wrote:

> Old Rafinesque is here—he talked me into a violent headache today—and threatens me with three or four more days of talk before he leaves town! He is very amusing and knows a great deal about plants and other matters—but will never advance science a single step. You doubtless know him well.

Torrey described Rafinesque's scientific acheivements in a similar fashion to the Swiss botanist Augustin Pyramus DeCandolle (1778–1841) on 30 August 1838: "Some of Mr. Rafinesque's works possess considerable merit, but they are so full of errors, that they are seldom consulted or quoted by our naturalists. . . ."

To Charles W. Short, Torrey commented about Rafinesque on several occasions. On 24 October 1831, he wrote concerning some Kentucky plants he had received from Short:

> . . . I have ascertained that the leguminose plant "No. 14" is Virgilia lutea Mx. In the unexpanded state of its flowers I did not recognize it. Mr. Rafinesque has with more than his usual propriety separated this plant from the old species of Virgilia. It certainly forms a new genus. As so many mistakes have been made in our botanical books respecting it, and Mr. R. is the first to correct them, we cannot deny him the credit to which he is entitled, notwithstanding his numerous faults and blunders. His genus Cladrastis will no doubt be adopted.[4]

On 23 October 1834, he asked Short about a *Hypericum:*

> Do let me have all the rare Hypericum of Kentucky. Do you know the Hyp. dolabriforme of Michx. I have specimens under this name, collected in Kentucky by Rafinesque—but they are miserable bits, and I am ashamed to keep them in my herbarium. Any rare Hypericums, especially the shrubby species, would be particularly acceptable at present.

SHORT'S OPINIONS EXPRESSED TO J. C. SHORT, TORREY, AND DARLINGTON. Ordinarily, Charles W. Short, a quiet, calm, kind, and most dignified gentleman, would not say anything to discredit another individual. When moved to anger, however, he must have dipped his pen in pure vitriol. He had very high standards of scientific workmanship, and could not tolerate Rafinesque's shipshod methods of collecting, preserving, and describing plants. Short (1833) had written a very creditable paper on these activities, and he followed its procedures faithfully. From the opinions expressed in his letters, it appears evident that Short wanted to speak kindly of Rafinesque, but could not do so because of misgivings about Rafinesque and his work.

Short, wary almost from the start, had been warned of Rafinesque's excesses as early as 15 November 1818 in a letter from his closest Philadelphia friend, Dr. Edward Barton, whose words he repeated in a hurried letter to brother John Cleves Short on 4 December:

> . . . some intelligence which I have lately from the Scientific Athens of America [i.e., Philadelphia] induces me to question M^{r}. Rafinesque's discriminating powers, and to alter in some measure the high opinion I had form [sic] of his proficiency in the Science of nat. history—My friend Dr. Edward Barton, of whom you have often heard me speak, and who since his return from Europe, still manifests that friendship and attention which sprung from the similarity of our dispositions & pursuits whilst students together, writes to me in this manner. "I am sorry that your new plants should fall into the hands of that maniac Rafinesque—he is so well known, that nobody pays any attention to his discoveries, and even should he hit upon something new, ten to one, whether it would be noticed. He is absolutely deranged—He makes Floras as [John] Melish does Maps—as they are called for—he will sit down and make you a Flora of a place he never saw with a fine parcel of new Genera, species &^{c}.—M^{r}. Correa [da Serra] says he is apprehensive Raf. will make a new genus of him[self]."

Short's later opinion was expressed in three letters to Torrey. The first, of 17 December 1834, was in reply to a request for information on the *Hypericum*.

> I know nothing of the *Hypericum dolabriforme* Mx. nor do I see any such species mentioned by him. I suspect therefore it is one of Rafinesque's fabrications, and that the plant is not found in Ky. I have no faith in, nor patience with Raf. and they have been still lower (if possible) of late than ever. He desired me not long since to send him certain Ky. plants, expressing a great desire to possess them, and promising anything in return. Willing to accommodate him, and wishing at the same time to test the truth of his numberless new discoveries in this state, I told him he sh[oul]d have what he asked of me, provided he would send me some of the new genera and species which he had met with here. This he declined doing "because he could not

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[4] Rafinesque's new genus *Cladrastis* was accepted, with *C. lutea* Michx. as the type species, although some recent authors have concluded that *C. kentuckea* (Dum.-Cours.) Rudd is the older name for this species.

> exchange his new plants!—he could only sell them!" This confirms my suspicions that he really has them not, and that his pretended discoveries exist only in pretension. I am the more confirmed in this opinion from his having acknowledged that he never met with *Iresine Celossoides* in this state, than which a more common plant does not exist in certain localities which he must have visited. All this, however entre nous; I have no wish to injure the poor fellow, and if he can live by imposing on others I have no objections. I am sorry, however, that I have met with so few *Hypericum* this season, since they seem to be at present an especial object of your investigation.

The next summer, on 11 August 1835, Short followed with more outlash against Rafinesque:

> Is not Rafinesque a madman! And have you honestly any confidence in him?—I sent to him this spring a considerable collection of plants, at his earnest desire, and beg'd him to let me have in return some of the many new genera and species which he had discovered in this country, that I might be aided in my search for and examination of them. Instead, however, of this his return package contained a miserable parcel of things, most of them as familiar to me as a "thrice told tale", together with some faded fragments of exotic affairs, render'd imposing and venerable by being labelled from "Etna", "Egypt", "Palestine" &^c^.&^c^.—He pronounces our common Dodecatheon a new species!, and does me the honor of offering me an Apotheosis among these twelve gods, by dedicating this species to me, which added to his twelve new species of that genus will make the full bakers dozen!—This blows up all my calculations, for I had set it down as one of my discoveries that you had gone too far in making two species, of D. Meadia & integrifolia.[5]
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> Can we not manage to silence this endless discover of new things, by raising among the botanical corps of the country an annuity for life? This if not a "divitial scheme" might at least afford him a decent competence, and prevent him from being under the necessity of gulling, or attempting to gull, the public with pulmels,[6] fire proofs & pearl hatching, together will [prevent] new genera & species without number in all the departments of nature—If I could lend a helping hand to effect this, and toward suppressing all his published nonsense I should be sure of having render'd a greater service to Science than I shall ever do in any other way.

Yet, on 25 October 1840, Short suggested, without effect, that a goldenrod might be named in honor of Rafinesque:

> I have a goodly stock of the plant, gather'd in the best stage for examination, which I will send you; and will for the present conclude my remarks on it by observing, that, should it prove sufficiently distinct both from *Solidago* and *Brachyris* [*Baccharis*] to form a new genus, another individual has a better claim to it than myself. Rafinesque, as you are aware, sent specimens of it to Decandolle in 1824; and although I have less confidence (entre nous) in that individual's pretensions than you seem to entertain, still as the original discoverer of the plant in question, he is entitled to any honor it may confer. I am not aware that any genus has yet been named after him; and if his admits of being sufficiently euphorized, by all means crown him with this "golden wreath."

Short and Darlington, as botanists, were dedicated to conducting exhaustive field work to assemble botanical specimens and knowledge, to building extensive herbaria through exchanges of specimens with other botanists, to the preparation of authoritative local floras, to the publication of their scientific work, and to the preservation of botanical history in a written form (Stuckey 1983). As early as 15 January 1829, Short wrote to Darlington about some confusion of names among some specimens that were improperly labeled. He explained:

> Some of my specimens you will very probably find improperly labelled, and some are not marked at all. This results in a great degree from their being collected at times when I had not books of reference at hand, and from my not taking time afterwards to do so; much confusion, moreover, may have arisen in their names, from the circumstance of my having shown them to Dr. or Mr. Rafinesque, who unhesitatingly called them

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[5] No species of *Dodecatheon* dedicated to or named for Dr. Short is known to have been published. *D. meadia* was named by Linnaeus and *D. integrifolia* was named by André Michaux.

[6] Short is apparently referring to the pulmistic prevention and cure of consumption, the subject of a book by Rafinesque (1829).

> by some name or other, which at the time I may have written down, although I have not the utmost confidence in their accuracy. No. 2 he professed alone to be unknown to him, and pronounced something new. I was unable under the circumstances in which it was found to distinguish its class, order, or genus.

On 1 July 1832, Short asked for Darlington's opinion of Rafinesque. At this time, Short was making botanical excursions within a 50-mile range of Lexington, and he found several plants he had not previously encountered.

> . . . although I cannot boast of the good fortune of my predecessor here, who in the same space, and with much less laborious search, would not have been satisfied with less than some ten or dozen new genera and thrice that N° of Species!—But what else, or what less, could have been expected of a "philosopher" in the back-woods of Kentucky who is even now, in the heart of Philadelphia, and in the ten thousand times trodden walks of Bartrams garden, making new discoveries daily!!—In sober seriousness what do you think of Rafinesque? Have you any faith whatever in his alleged discoveries? Will all the patient labours of American botanists, for the next half century, be able to extricate the science from that interminable chaos into which he will throw it, if any credence is given to him?—I had long since taken the liberty, on my own responsibility, of setting him down as an unblushing and shallow-pated pretender to everything; but this decision of mine has been somewhat shaken by seeing that Torrey is disposed to give him very considerable credit, and that the Editor[7] of the Phila. Jour. of Geology &^{c} (how far competent to decide I know not) places him at the very head of American Naturalists—Nevertheless I do most heartily wish that the "philosopher" and "pulmist" could have been satisfied to restrict his investigations to the antediluvian history of China or the post deluvian chronicles of the thousand and one aboriginal nations of America.

Darlington concurred in this opinion of Rafinesque. On 12 January 1833 he wrote to Short:

> Your opinions of that singular genius Mr. Rafinesque, accord very much with my own; though I have but little personal knowledge of him—not having seen him for nearly thirty years. He makes sad confusion in natural science, by his itch for novelty; & never can be *authority* for any thing. I think Mr. De Candolle quotes him with too much confidence—though he often inserts marks of doubt, after his *new* genera and species. The great mischief, in natural science, is imposing *new names*, and starting new arrangements, & creating new genera, unnecessarily; and this is the begetting sin of Rafinesque.

Darlington, in his account of the "Progress of botany in North America" (1849), summarized his opinion of Rafinesque:

> This eccentric and rambling naturalist—although he had, by long experience and observation, acquired considerable knowledge, and moreover issued several other botanical publications, in subsequent years,—yet he made statements so little reliable, held such peculiar views, and withal was so addicted to extravagant innovations in nomenclature, that his productions, generally, were rather injurious than beneficial to the science.

Later Short compared the results of his efforts at rediscovering the genera that André Michaux named and described from Kentucky in his *Flora Boreali-Americana* (1803) with those supposedly discovered by Rafinesque. Concerning Michaux's plants, Short wrote to Darlington on 13 July 1838.

> It affords me much pleasure, indeed, to have the means of establishing so many of the discoveries of the excellent and enterprizing Frenchman, whose reports, in relation to some of our western plants, were almost discarded. It has been my good fortune to find, in profuse abundance in many different localities, his *Bellis*

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[7] Short is apparently referring to George W. Fetherstonhaugh's *The Monthly American Journal of Geology and Natural Science* (Philadelphia), of which volume 1, pp. 1–576 appeared in 1831–1832. In the July issue (1831, p. 43) the editor refers to Rafinesque as "a perfect master of the subject. . . ." This reference was to Rafinesque's forthcoming paper on osteological remains at Big Bone Lick, Kentucky, which was published later in the volume (pp. 355–358). The entire volume, with an introduction by George W. White, was reprinted in 1969 by Hafner Publishing Co., New York.

integrifolia about which even Nuttall expressed a doubt; and his *Cunila glabella, Leptanthus ovalis, Pachysandra procumbens, Euphorbia dentata* &c.&c. have all occur'd to me within the last few years, and have all, I think been sent to you.

Very different from this has been the result of my search after the many new genera and species of my old friend Rafinesque; many—by far the most of which, I fear, will ever repose in his own imagination, or within the Labor of that sealed volume to all human eyes—the *Autikon Botanikon* [Rafinesque (1840)]!

GRAY'S PUBLISHED OPINION. Following Rafinesque's death on 18 September 1840, Asa Gray published a list of Rafinesque's botanical publications and wrote an evaluation of his work. Gray recognized that botany was Rafinesque's favorite pursuit in natural history, and that in his early days he showed considerable potential and was in some respects greatly in advance of other botanical writers, but that his labors had been disregarded or undervalued on account of his peculiarities. Of Rafinesque's earlier contributions, Gray (1841) wrote:

> In these, he had certainly shown no little sagacity; and, considering his limited advantages, he must be deemed a botanist of unusual promise for that period, notwithstanding the defects which, increasing in after life, have obscured his real merits, and caused even his early writings to be in a great measure disregarded. The botany of the United States offered, at that time, a fine field to a botanist acquainted with natural affinities; and Rafinesque was the only person in this country, who had any pretensions to that kind of knowledge. All we can justly say is, that he possessed talents which, properly applied, would have raised him to a high rank in the science, and that he early apprehended the advantages of the natural classification, although he was by no means well grounded in structural and systematic botany. As early as 1814, indeed he sketched a general classification of organized beings [Rafinesque (1814)] to which he continued to attach great importance; but there is nothing new in it except the names, the botanical portion being merely an anagram of Jussieu's leading divisions. His fuller developments of this system certainly contain much that is novel, but at the same time very absurd.

Of Rafinesque's later writings, Gray wrote:

> Many of Rafinesque's names should have been adopted; some as matter of courtesy, and others in accordance with strict rule. But it must be remembered, that the rule of priority in publication was not then universally recognized among botanists, at least as in present practice, (the prevalence of which is chiefly to be ascribed to the influence of De Candolle;) the older name being preferred cateris paribus, but not otherwise. It is also true, that many of the scattered papers of Rafinesque were overlooked by those who would have been fully disposed to do justice to his labors, had they been acquainted with them; and a large portion of the genera proposed in his reviews of *Pursh, Nuttall, Bigelow* &c.,[8] were founded on their characters of plants which were doubtfully referred to the genera in which they were placed or were stated to disagree in some particular from the other species. One who, like Rafinesque, followed the easy rule of founding new genera upon all these species, could not fail to make now and then an excellent hit; but as he very seldom knew the plants themselves, he was unable to characterize his proposed genera, or to advance our knowledge respecting them in the slightest degree. In his later publications, this practice is carried to so absurd an extent as entirely to defeat its object.
>
> A gradual deterioration will be observed in Rafinesque's botanical writings from 1819 to about 1830, when the passion for establishing new genera and species, appears to have become a complete *monomania*. This is the most charitable supposition we can entertain, and is confirmed by the opinions of those who knew him best. Hitherto we have been particular in the enumeration of his scattered productions, in order to facilitate the labors of those who may be disposed to search through bushels of chaff for the grain or two of wheat they perchance contain. What consideration they may deserve, let succeeding botanists determine; but we cannot hesitate to assert that none whatever is due to his subsequent works. These, like many of the preceding, are little known; but we shall continue our enumeration and future writers can correct our opinion wherever they think we have done the author injustice.

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[8] Rafinesque's reviews of the floras of Pursh, Nuttall, Bigelow, etc. were published in *The American Monthly Magazine and Critical Review* during 1818 and 1819 and are cited as numbers 258, 264, 265, and 288 in the "Bibliography of C. S. Rafinesque" (Fitzpatrick 1911; Boewe 1982).

Gray's criticism of Rafinesque's botanical contributions was the strongest that had been put into print, and undoubtedly set the criterion for subsequent botanists, who essentially ignored Rafinesque's works. Gray's influence persisted for nearly a century before a new generation of botanists began the task of sorting through Rafinesque's proposed botanical names, descriptions of new taxa, and surviving herbarium specimens.

In a review of some early North American botanical publications, Gray compared the work of Thomas Nuttall with that of Rafinesque. Of Nuttall, Gray (1844) wrote:

> Probably few naturalists have ever excelled him in aptitude for such observations, in quickness of eye, tact in discrimination, and tenacity of memory. In some of these respects, perhaps, he may have been equalled by Rafinesque,—and there are obvious points of resemblance between the later writings of the two, which might tempt us to continue the parallel:—but in scientific knowledge and judgment, he [Nuttall] was always greatly superior to that eccentric individual [Rafinesque].

SHORT'S OPINIONS FOLLOWING RAFINESQUE'S DEATH. Following Rafinesque's death, Short continued to make comments about his work. A final opinion was written to Darlington on 10 May 1841:

> So, poor old Rafinesque is dead; and all his labours "in the deep bosom of the ocean buried!"—What has become of his collection?[9]—It must have been a queer medley; and yet I should like to have the picking of it over, for I long to see some of the many new genera and species which he found in all parts of Kentucky, which I have look'd in vain for—I have in my Herb^{m}. a few specimens from him, so miserably bad that they have been eye-sores to me whenever I have met them; but I suppose I must keep them now as momentoes of the eccentric giver.

Short conducted an extensive botanical correspondence with Asa Gray during the late 1840s and throughout the 1850s, and the subject of Rafinesque appeared in several of these letters. Short maintained that Gray, in his writings, had been unfair in his appraisal of Nuttall by linking and comparing him to Rafinesque. On two occasions, 3 October 1856 and 19 October 1859, Short inquired:

> . . . I have a greater respect and regard for this Pioneer of Western Botany than you seem to have had; for I remember on some occasion you compared him to Rafinesque! Now every body knows that poor Raffy was a most bare-faced liar, not to say a rogue; and the only possible way of apologizing for his gross frauds and deceptions is by Mr. Durand's charitable supposition that he was deranged.[10] On the contrary, have you not found Nuttall truthful and reliable on all occasions?
>
> Have you not done him [Nuttall] injustice in some of your notices regarding him, in comparing him to Rafinesque? The latter I always regarded as an unprincipled charlatan, whilst in Mr. Nuttall I never saw anything but straight forward truth and honesty. I hope that we shall be favoured with a full and just biographical memoir of him.

If Gray answered on this subject, his replies are not known.[11]

Typical of those botanists who followed in the wake of Rafinesque was George Engelmann, who was interested in receiving some books by Rafinesque that had been offered by Short. On 12 June 1855, Engelmann wrote to Short:

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[9] The fate of Rafinesque's herbarium, most of which was destroyed, has been described in considerable detail by Merrill (1949, pp. 33–37), Pennell (1942, 1945), and Stuckey (1971a,b).

[10] Short's reference must be to a letter of 4 June 1856 from Elias Durand, wherein Durand described his attitude toward Rafinesque and how he had obtained and then proceeded to discard most of Rafinesque's herbarium (Pennell 1945).

[11] No letters from Gray after 1856 are known to be on deposit in the Short collection in the library of the Filson Club, Louisville (Davies 1945).

> Your offer of Rafinesque's writings I thankfully accept; though I believe with you that the trouble of sifting the little good wheat from the mass of chaff is vastly greater than to go to work anew without paying any attention to him.

After receiving and examining the books, Engelmann wrote again, on 13 October 1855:

> I hope you will not think too hard of me for my neglect in acknowledging the receipt of those books of Rafinesque's. They have been in my hands for some time and I was a good deal interested in looking through them; not so much I must confess at the amount of research and knowledge displayed in them as at the barefaced impudence with which he urges his decisions and assails better men. The criticism on Nuttall's Genera [*The Genera of North American Plants* . . . (1818)] is particularly rich!

CONCLUSIONS

The private opinions of Rafinesque expressed by eastern North American botanists during the first half of the nineteenth century were numerous and for the most part uncomplimentary. Although Eaton, Torrey, and Gray praised his scientific efforts in certain respects, they also did not hesitate to condemn his personal and scientific shortcomings. It is clear from Short's comments that he had nothing constructive to say about Rafinesque's personality and scientific work. Since most of the uncomplimentary comments were expressed in private correspondence, they generally were not available to the botanical public for evaluation; but Gray's opinion, expressed in his published memorial of Rafinesque, served as a summation of the opinions that had been generated among botanists. Gray's publication certainly influenced American botanists during the latter half of the nineteenth and early part of the twentieth centuries, during which time Rafinesque's botanical work was largely ignored. Because of the clarification of the rules of priority and homonymy in botanical nomenclature, Rafinesque's published scientific botanical names must now be taken into consideration in taxonomic studies.

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Bartonia No. 52: 42–43, 1986

The Taxonomic Status of *Viola appalachiensis* Henry

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Viola appalachiensis was described in 1952 by Leroy K. Henry in his treatment of the violets of Western Pennsylvania and was based on specimens collected from Pennsylvania, Maryland, and West Virginia. These violet specimens were first identified as *V. walteri* House and later as *V. labridorica* Schrank (Platt 1950). Henry (1952) distinguished his taxon from *V. walteri* by its stipule morphology and its slightly pubescent to glabrous nature. He distinguished it from *V. labradorica* by its mat-forming, stoloniferous habit. Russell (1965) chose not to recognize *V. appalachiensis* and suggested that it represented depauperate plants of *V. walteri* or *V. conspersa* Reichenbach.

After examination of type material (CM), and most other known specimens of *V. appalachiensis* (CM, WVA, PH), I have concluded that the variation patterns fall well within the phenotypic range of *V. walteri*. *V. walteri* may be glabrous to heavily pubescent, with the pubescence widespread throughout the plant or localized on certain parts, e.g. petioles, veins, or lamina margins. This extreme variation in pubescence appears to be common to other violets (McKinney and Blum 1977), and apparently is independent of other morphological features as well as geographical or ecological factors. Furthermore, stipule morphology also varies intraspecifically in violets, although not as extensively as pubescence. In *V. walteri*, the stipules vary from slightly laciniate-cut, as with the type noted for *V. appalachiensis*, to the more typical and deeper laciniate-cut noted for *V. walteri*. Stipule morphology and pubescence vary independently of each other, and thus as a combination of characters, provide no basis for delineating two separate species.

In conclusion, I believe the variation pattern noted does not warrant recognition of *V. appalachiensis* at the species level or at any infraspecific level. The name should be placed into synonomy under *V. walteri* House. An abbreviated and amended description of *V. walteri* is provided as a supplement to the existing literature on Eastern United States violets.

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V. muhlenbergii var. *multicaulis* T. & G., Fl. N. Am. 1: 140. 1838.
V. canina Walter, Fl. Car. 219. 1788.

Perennial herb; stems prostrate, mat-forming, and stoloniferous. Leaves orbicular to ovate, base cordate, apex obtuse; finely pubescent throughout or limited to upper lamina surface, lamina margins, and veins; lower lamina usually suffused with purple. Stipules laciniately fringed, sometimes sparingly so. Flowers pale to dark violet, lateral petals bearded. Sepals ovate to lanceolate. Capsules ovate to ellipsoid; seeds brown.

Rich wooded slopes, rocky ledges; Southwestern Pennsylvania south to Georgia, west to Texas.

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Bartonia No. 52: 44–48, 1986

Rare New Jersey Plant Species Rediscovered

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At the close of the 1985 field season, the New Jersey Natural Heritage Program through its contractors, collaborators, and staff, had documented an estimated 700 occurrences of rare New Jersey plant species. Among these, were a number of rediscoveries of species previously classified by NJNHP as historic or presumed extirpated. Eleven of the more significant discoveries are discussed here.

New Jersey specimens of these taxa were examined at CU, CHRB, GH, PH, and NY. General distribution and habitat notes are from Fernald (1950) and Gleason and Cronquist (1963). Current state status for some taxa was obtained from several state Heritage Programs and also from The Nature Conservancy's national data base. Nomenclature follows Kartesz and Kartesz (1980) except for *Alisma triviale* Pursh, *A. subcordatum* Raf., *Fraxinus tomentosa* Michx f., and *Kuhnia eupatorioides* L. Voucher specimens for all taxa, except *Platanthera flava* var. *flava*, will be placed in CHRB and duplicates for some in PH and NY.

Alisma triviale

Irv Black, Tom Halliwell, and I found this species on 3 August 1985 growing on the dry bottom of a limestone sink pond near Johnsonburg, Warren County. This appears to be an addition to the state's flora.[2] Despite the current unsettled nomenclature and taxonomic status of this taxon, we found it to be distinct and recognizable from *A. subcordatum*, which in New Jersey is a widespread and common species. Plants examined had flowering scapes measuring in excess of one meter. The scarious margins of the sepals were conspicuous (even without a hand lens), and achenes measured 3 mm in length.

Calamagrostis pickeringii

Last collected 47 years ago, *Calamagrostis pickeringii* was rediscovered in New Jersey near Bear Swamp Hill, Burlington County, by Jim Stasz on 23 July 1985. The species was first collected in the state from Lawrence, Mercer County, by K. K. Mackenzie in 1915, but identified by Mackenzie as *Calamagrostis inexpansa*. The species went undetected in the state until 1938 when it was collected by B. Long from a bog along the Oswego River near Sim Place, Burlington County. Long's specimen was annotated to *C. pickeringii* by M. L. Fernald in 1942 and the Mackenzie specimen was determined *C. pickeringii* by S. J. Smith in 1953. The identities of both specimens were reconfirmed in 1980 by C. W. Greene. The distribution of the species is disjunct and local. Its range is Nova Scotia and Newfoundland, Mount Katahdin, Maine, Isle

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[1] The New Jersey Natural Heritage Program was established in 1984 as a joint venture of the New Jersey Department of Environmental Protection and The Nature Conservancy, and is conducting an inventory of the state's rare and endangered flora and fauna.

[2] The Abraitys 1964 site record for this species in Hough (1983) was rejected by Abraitys when he revisited the site in the early 1980's with Tom Halliwell (Tom Halliwell pers. comm.).

Royale, Michigan, the White Mountains and southeast New Hampshire, the Green Mountains of Vermont, the Adirondacks of New York, northeast Massachusetts, and the Coastal Plain of Long Island (Bob Zaremba pers. comm.) and southern New Jersey. On 1 September 1985, Mike Barnett, Ted Gordon, Jim Stasz, and I found an additional New Jersey location (possibly Long's 1938 site) along the Oswego River east of Oswego Lake, Burlington County. The species was mostly vegetative and locally abundant in several open bogs where it was associated with *Muhlenbergia torreyana*, *Narthecium americanum*, *Calopogon tuberosa*, *Lobelia canbyi*, and *Aster nemoralis*. The species was found again on 29 September 1985 by Ted Gordon and Jim Stasz along the Wading River, west of Jenkins, Burlington County.

Muhlenbergia capillaris

In the U.S., this species occurs from Florida to Texas, north to Massachusetts, Illinois, and Kansas. Except for Virginia, where the species is locally frequent (Steve Croy pers. comm.), it is nearly non-existent in the northeastern portion of its range. It is reported as historic or extirpated in the following states: Ohio (1 county, last collected in 1930's, Stuckey and Roberts 1982), Pennsylvania (1 record 1864, Tom Smith pers. comm.), Maryland (1 record, not recently seen, Dan Boone pers. comm.), Delaware (1 record 1893, Tucker et. al. 1979), New York (2 records, last collected 1915, Steve Clemants pers. comm.), and Massachusetts (3 records, last collected ca. 1905, Bruce Sorrie pers. comm.). Single extant occurrences are known in West Virginia (Brian McDonald pers. comm.) and Connecticut (Les Mehrhoff pers. comm.). In New Jersey it previously had been recorded from six definite localities in six counties. The earliest dated specimen was collected in 1879 by W. H. Leggett on Little Snake Hill, Hudson County. The most recent specimen found was a 1918 collection by W. D. Miller from the Watchung Mountains at what is now Watchung, Somerset County. Although specimen labels show a wide range of habitat—Coastal Plain sands to limestone woodlands of the glaciated Highlands—half of the collections were made on trap rock. I concentrated my search for this species on trap rock ridges of the Watchung Mountains, and on 22 September 1985, I found a single clump with 28 culms in Scotch Plains, Union County, approximately three miles northeast of Miller's 1918 location. It grew in open shade on an abruptly sloping, southwest facing ledge top. Associated species included *Aristida purpurascens*, *Sporobolus vaginiflorus*, *Scleria pauciflora* var. *caroliniana*, *Aristolochia serpentaria*, *Crataegus uniflora*, *Linum virginianum*, *Asclepias verticillata*, *Aster laevis*, *A. linariifolius*, and *Helianthus divaricatus*. A second site with four clumps of *M. capillaris* was found on 4 October 1985 on Preakness Mountain in Passaic County by me and Tom Breden. The situation was similar to the last except for the absence of the *Scleria* and the presence of *Scutellaria leonardii*.

Platanthera flava var. **flava**

Platanthera flava var. *flava* occurs throughout most of the southeastern U.S. Recent works do not credit the taxon to New Jersey. Correll (1978), Fernald (1950), and Luer (1975) exclude New Jersey from its range. In herbaria, I have seen only one New Jersey collection clearly referable to this variety—a specimen from Old Bridge, Middlesex County collected by W. D. Miller in 1916. Specimens collected by B. Long and H. B. Meridith from Coopers Creek, Camden County, are probably var. *flava* but seem to be intermediate with the more frequent var. *herbiola*. In early June, 1985, the var. *flava* was rediscovered in New Jersey by Gil Cavileer and Keith Seager growing in a wooded swamp near Rio Grande, Cape May County. The plants grew in a single dense colony with few flowering scapes. Other species of southern affinities found in this swamp were *Listera australis, Tipularia discolor, Populus heterophylla,* and *Fraxinus tomentosa.*

Carex jamesii

Carex jamesii grows in rich, often calcareous woods from southern Ontario and New York, west to Minnesota (Wheeler 1985), and south to Tennessee and Virginia. Much suitable habitat occurs in New Jersey, but the species is rare. It was first collected in the state by K. K. Mackenzie in 1913 from Delaware, Warren County. In 1924 B. Long collected it in Mercer County about 1 mile south of Lambertville. No additional collections or reports are known until 1969 when the species was relocated at Mackenzie's Warren County site by V. Abraitys.[3] Several attempts failed to relocate this station in the past few years. On 1 June 1985, while exploring Holcombe Island at Lambertville, Hunterdon County, I found a few clumps of this diminutive, but distinctive sedge. It was growing in sandy soil in open woods within a few meters of the Delaware River. Other nearby plants of interest included an extensive stand of *Carex grayii, Arisaema dracontium,* and *Ellisia nyctelea.*

Vicia caroliniana

Vicia caroliniana grows in rocky woods, bluffs, and stream banks throughout most of the northeastern and southeastern U.S. The species has always been rare in New Jersey and was last collected in 1910 by K. K. Mackenzie from the Sparta Mountains, Sussex County. In the mid and late 1800's, T. C. Porter made several collections from 3 or 4 localities along the Delaware River in Hunterdon and Warren counties. In 1964, V. Abraitys reported two plants at Porter's Phillipsburg site in Warren County (Snyder 1984). This site has not been relocated in recent years. On 26 May 1985, with scant directions from Mackenzie's field journal, I attempted to retrace Mackenzie's 1910 trip from Sparta Glen to Ogdensburg via Sparta Mountain. Like Mackenzie before me, I found *Vicia caroliniana* to be locally frequent near the summit of the mountain. It grew in rocky, grassy glades under *Carya, Quercus,* and *Fraxinus.*

Linum sulcatum

The distribution of *Linum sulcatum* is mostly midwestern where it grows in dry prairies and upland woods from Michigan, west to Manitoba, and south to Georgia. It is rare in the northeast and its distribution is scattered and local. No extant occurrences are known in Vermont (Countryman 1978), Massachusetts (Bruce Sorrie pers. comm.), Connecticut (Les Mehrhoff pers. comm.), Pennsylvania (Tom Smith pers. comm.), and Maryland (Dan Boone pers. comm.). The species is classified as rare or potentially rare in New York (Steve Clemants pers. comm.), Ohio (Roberts and Cooperrider 1982), Virginia (Steve Croy pers. comm.), and West Virginia (Brian McDonald pers. comm.). In New Jersey the species has been collected from single sites in Bergen, Hunterdon, and Camden counties. Two early collections are known from Sussex County, the most recent being a 1914 collection from Ogdensburg by K. K. Mackenzie. A number of plants were found about 1 mile north of this last locality by Tom Breden and me on 17 October 1985. The plants were growing at the crest of a dry, open, limestone hillside dominated by scattered shrubs of *Juniperus virginiana* and *Celtis tenuifolia*. A number of species of predominantly midwestern affinities occur, or have occurred, here: *Asclepias verticillata, Anemone cylindrica, Bouteloua curtipendula, Chrysopsis camporum, Kuhnia eupatorioides*, and *Solidago rigida*.

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[3] Abraitys (1980) credits *Carex jamesii* to Hunterdon County in his check-list for the county. There is no Hunterdon County record listed in his field notes, and he never indicated to me that he had seen the species in the county. I suspect that Abraitys' record is based on Long's 1924 collection which was made near the Hunterdon/Mercer County line in Mercer County.

Euphorbia purpurea

Euphorbia purpurea has been collected from only eight U.S. states—North Carolina, Virginia, West Virginia, Maryland, Delaware, New Jersey, Pennsylvania, and Ohio—and is considered rare in each. Two states, Delaware and Ohio, list the species as extirpated (Tucker et. al. 1979; Roberts and Cooperrider 1982). The species was first collected in New Jersey near Woodstown, Salem County, by C. D. Lippencott in 1895. Between 1919 and 1928, at least three different localities were discovered in lower Cape May County. Prior to this year's field season, the last known New Jersey collection was made in 1946 from a swamp west of Wildwood Junction, Cape May County. On 24 May 1985, Jim Stasz and I searched for this last site. While exploring in opposite directions along the same creek, we independently and simultaneously discovered two subpopulations. The plants were large and some stood nearly two meters high. Most were vegetative, but a few were found in full flower. All were restricted to mucky seeps in open areas adjacent to the small creek. The species was locally abundant and some 200 clumps were counted. Other noteworthy species found here were *Sphenopholis pensylvanica, Carex mitchelliana, Caltha palustris, Chrysosplenium americanum, Viola conspersa*, and *Cirsium muticum*. The last four species are all rare occurrences on New Jersey's Coastal Plain.

Triadenum fraseri

I found a colony of about 80 plants of this northern species in a small, herbaceous marsh along the Lamington River southeast of Succasunna, Morris County, on 9 September 1985. On a return visit on 19 September 1985, no additional colonies were located, but several plants of *Triadenum virginicum* were found in an open, boggy area about a mile south of the first site. *Triadenum virginicum* and *T. fraseri* are closely related, differing chiefly in sepal and style characteristics, and some authors consider *T. fraseri* to be a subspecies or variety of *T. virginicum*. In New Jersey *Triadenum virginicum* is common and occurs in swamps and bogs throughout the state. There are few New Jersey collections of *T. walteri* and all are specimens that were originally named *T. virginicum*. The most recent specimen seen is a 1952 Warren County collection by R. L. Schaeffer, Jr.

Triadenum walteri

The early floras of Britton (1889), Stone (1911), and Taylor (1915) cite a single New Jersey collection from "near Camden" made in the 1800's by J. K. Potts. This specimen was not found at PH. Gleason and Cronquist's (1963) range for *Triadenum walteri* is Florida to Texas, north to Maryland and Missouri, Fernald's (1950) range is the same except for the addition of "?N.J." in parentheses. One locality is reported from Cape May County by Brown and Wherry (1970) and is apparently based on collections made by L. Griscom et al. and K. K. Mackenzie in 1921 and by O. H. Brown in 1927 from a wooded swamp near Wildwood Junction. No other herbarium or literature records were found. While exploring a wooded swamp near Goshen Crossing, Cape May County, with Jim Stasz, I found several plants of what I took to be this species. On that date, 24 July 1985, the plants were barely in bud and identification was made primarily on the general appearance of the plants. The identification was confirmed on 20 September 1985 when we returned and collected specimens with mature fruit.

Rhododendron atlanticum

Jim Stasz and I found this southern species on 24 May 1985 in dryish pine and oak woods west of Wildwood Junction, Cape May County. Plants found were stoloniferous and formed intricate, knee-high colonies. The corollas were white, making it forma *confusum* Fern. Previous to our discovery the only New Jersey specimens known were those collected by B. Long between 1925 and 1940 from four localities in Cumberland and Salem counties. Sight records for the species have also been made by Gil Cavileer (pers. comm.), J. L. Edwards, and Frank Hirst (V. Abraitys pers. comm.). The species is perhaps more frequent in New Jersey than records now indicate since it is easily overlooked when not in flower.

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New Records of Some Rare DelMarVa Sedges[1]

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The DelMarVa Peninsula hosts a diverse sedge flora including many rare species. However, the current status of many members of the Cyperaceae on the Peninsula is poorly known. Notes on the ecology and distribution of 23 species gathered in Delaware and the Eastern Shore of Maryland are detailed below. All localities listed are believed to be new stations for each species unless otherwise identified. Our collections include one new Peninsula record, two new state records, and at least twelve new county records. Statements of new records are based on available information as found in the published literature and records of the Claude E. Phillips Herbarium.

Pertinent literature and local herbaria have furnished most of the distribution information. First-hand observations in the field during the 1983–1985 seasons have provided the ecological data. A voucher specimen (merely a fragment in the case of small populations) from every locality is deposited in the Claude E. Phillips Herbarium at Delaware State College (DOV). Duplicate vouchers of some species are also deposited at the Academy of Natural Sciences of Philadelphia (PH). The nomenclature follows Kartesz and Kartesz (1980) and U.S.D.A. (1982) except for *Scirpus smithii*.

"Rare" designations for the 23 sedges and their co-occurring species are given according to the following listings: "USA" (Arnett 1983); "DE" (Tucker et al. 1979); "MD1" (Broome et al. 1979); "MD2" (Boone 1984); "VA" (Porter 1979). Of the 22 native sedge taxa we discuss, 19 are noted in one or more of the above list ,

1. **Carex barrattii** (rare: USA, MD2, VA)

DELAWARE: New Castle County: Townsend, wooded depression in swampy woods, 31 May 1984, DOV12310; Delaneys Corner, sunny swale, 9 Jul 1985, DOV12574. MARYLAND: Queen Anne's County: E of Sudlersville, swampy woods, 5 Aug 1985, DOV12683.

Growing conditions of this sedge ranged from shade to full sun and moist to flooded. However, it seemed to flower the most when growing in partially shaded, very wet soil. Two of the populations of *C. barrattii* were small (sites one and three) while one was moderately large (site two). *Acer rubrum, C. bullata* (rare: MD2), *C. gigantea* (rare: MD1, MD2), *C. lupulina, Liquidambar styraciflua,* and *Scirpus cyperinus* were frequently found with *C. barattii*. These collections are from the area of the Peninsula in which DelMarVa Bays are common.

This sedge is not common on DelMarVa, but is probably more frequent than collections indicate because it flowers sparingly. We saw sterile plants which were almost certainly *C. barrattii* at four other sites in the above-listed counties. The collection from Townsend is a rediscovery of a population from which plants were last collected in 1935 (DOV). At Delaneys Corner, it was last collected in 1872 (PH). This species was also collected in Caroline County, Maryland, in 1863 (PH). James L. Stasz (pers.

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comm. 1984) reports a population in Wicomico County, Maryland. Our Queen Anne's County collection is evidently a new county record of this sedge.

2. Carex exilis (rare: DE, MD2)

DELAWARE: Sussex County: Angola, sphagnous *Acer rubrum* swamp, 31 May 1984, DOV12318.

Fewer than five tussocks of *C. exilis* were found in this shaded habitat. They were growing in close association with numerous plants of *C. canescens* and *Drosera rotundifolia* (rare: DE). There are only two previously recorded collections of *C. exilis* from DelMarVa: 1875 (PH) and 1940 (DOV). Only two collection localities have been reported south of DelMarVa for this primarily boreal species (Reznicek and Ball 1980).

3. Carex frankii

DELAWARE: New Castle County: N of Rockland, partially shaded floodplain of Brandywine Creek, 12 Oct 1983, DOV10514; NE of Bellefonte, partially shaded bank of small tidal stream near Delaware River, 8 Jul 1984, DOV12434. MARYLAND: Cecil County: NW of Rising Sun, sunny floodplain of Octoraro Creek, 16 Jul 1985, DOV12576.

About five clumps of *C. frankii* grew at each of the three collection sites at the upper edge of a floodplain in moist soil and partial to full sun. Associates of this mainly midwestern sedge (Fernald 1970) included *C. lurida* at sites one and two and *Acer negundo* at sites one and three. Mackenzie (1935) does not record *C. frankii* from Delaware, and Tatnall (1946) records only a 1928 Worcester County, Maryland, collection. Our first and second collections are apparently new Delaware state records, and the third is a new Maryland county record.

4. Carex gigantea (rare: MD1, MD2)

DELAWARE: New Castle County: Townsend, wooded depression in swampy woods, 7 Jul 1984, DOV12430; E of Delaneys Corner, shrubby, logged-over swampy woods, 19 Jul 1985, DOV12581; Kent County: NW of Hartly, wooded depression in swampy woods, 19 Jul 1985, DOV12583. MARYLAND: Queen Anne's County: E of Sudlersville, open depression in swampy woods, 5 Aug 1985, DOV12682.

This late-fruiting sedge was often abundant at the above sites and was usually found fringing shallow, often flooded, woodland depressions sometimes called "Carolina" or "DelMarVa" Bays. Occasionally *C. gigantea* was found dispersed throughout shallower depressions. It often grew in shade but seemed to thrive best in nearly full sun. It was almost constantly associated with *C. lupulina* and *Cephalanthus occidentalis* when found in swamps characterized by *Acer rubrum, Diospyros virginiana,* and *Liquidambar styraciflua*. Frequent associates were *Dulichium arundinaceum, Proserpinaca palustris,* and *Scirpus cyperinus.*

The specimens cited above represent several collections in each county listed. We observed *C. gigantea* at twenty sites in southwestern New Castle, northwestern Kent, and eastern Queen Anne's counties. *Carex gigantea* is generally rare on the Peninsula, but historical collections and our field work indicate that it is frequent within the small region in which "Bays" are numerous. This species has been collected several times, last in 1940 (PH), at a few localities in southwestern New Castle County (including our first and second sites). Only northern New Castle County (PH) and Worcester County, Maryland (Broome et al 1979), have been recorded as additional collection sites of this sedge. Our Kent and Queen Anne's counties' collections are new county records for *C. gigantea,* which reaches its northern limit of range in Delaware (Fernald 1970).

5. **Carex lanuginosa** (rare: MD2)

DELAWARE: New Castle County: SE of Vandyke, sunny edge of wooded natural pond, 7 Jul 1984, DOV12429.

Carex languinosa was frequent at the wet margin of a small pond (or DelMarVa Bay) dominated by *Diospyros virginiana* and grew with the more numerous plants of *C. lupulina* and a few plants of *Isoetes engelmannii* (rare: DE, MD2). All previous DelMarVa collections of *C. lanuginosa* are from New Castle County (last in 1897, PH).

6. **Carex lupuliformis** (rare: DE, VA)

DELAWARE: New Castle County: E of Delaneys Corner, shrubby, logged-over swampy woods, 19 Jul 1985, DOV12586; SW of McKays Corners, swampy woods, 22 Jul 1985, DOV12476; S of Vandyke, edge of open depression in swampy woods, 23 Jul 1985, DOV12474.

Although there was a large population in full sun at the first locality, this sedge usually grew in small populations in locations ranging from partial shade to full sun. Its swampy habitats were associated with DelMarVa Bays and included *Acer rubrum, C. lupulina, Clethra alnifolia,* and *Liquidambar styraciflua* at each of the three collection localities.

Other associates of *Carex lupuliformis* included *C. gigantea* (rare: MD1, MD2) at sites one and two, and *C. bullata* (rare: MD2) and *Ludwigia sphaerocarpa* at sites one and three. Of five previous historic DelMarVa collections, four are from New Castle County, where *C. lupuliformis* was last seen in 1897 (DOV), and one is from Worcester County, Maryland (Shreve 1910). The species was found, but not collected, at Porters Crossing and Whiton Crossing on the Pocomoke River (Worcester County, Maryland) in "forested, wet floodplain in shade" on 2 Aug 1984 (William S. Sipple, pers. comm. 1985). Our records now indicate a total of 10 sites for the Peninsula. Reznicek and Ball (1974) report the species as uncommon throughout its range, and MacKenzie (1935) notes that its occurrence is local.

7. **Carex mitchelliana** (rare: DE)

DELAWARE: Kent County: N of Milford, sunny ditch, 31 May 1984, DOV12351; Sussex County: E of Ellendale, partially shaded mud of shallow stream, 21 Jun 1984, DOV12439; New Castle County: N of Mt. Pleasant, shaded floodplain of Joy Run, 4 Jun 1985, DOV12567.

The habitats of this sedge ranged from shade to full sun but were always very wet. The first population was very large, but the second and third consisted of just one and two clumps respectively. Tatnall (1946) records only one collection (Sussex County, 1875). Bruederle (1985) reports one historic population in New Castle County and one extant population in Kent County, the latter the same as our first site (pers. comm. 1985).

8. **Cyperus aristatus** var. **aristatus**

MARYLAND: Cecil County: N of Conowingo, sunny, slightly moist soil overlying a serpentine outcrop, 29 Aug 1984, DOV12522.

This short sedge was frequent and grew with *Fimbristylis annua* (rare: DE) and *Scleria pauciflora* in a serpentine barren. Tatnall (1946) does not list it, and Horvat (1941) does not cite any DelMarVa specimens. Evidently, this collection is a new record for the Peninsula, even though *C. aristatus* inhabits serpentine barrens in nearby Chester County, Pennsylvania (Pennell 1910).

9. Cyperus brevifolioides

MARYLAND: Cecil County: North East, freshwater intertidal zone of Northeast River near high tide limit, 29 Aug 1984, DOV12590. DELAWARE: New Castle County: N of Rockland, sunny floodplain of Brandywine Creek, 17 Aug 1985, DOV12702.

At each collection site *C. brevifolioides* occurred as a single, large, dense stand in sunny, moist soil. It grew near *Eupatorium perfoliatum, Rudbeckia laciniata,* and *Scirpus cyperinus* at site one. At the nontidal second site, it grew in a weedy, occasionally mowed, lawnlike portion of a floodplain near *Lysimachia nummularia* and *Potentilla simplex*. In the nearby Philadelphia area there are very few collections of this unusual *Cyperus* from nontidal areas as the species is nearly restricted to freshwater intertidal zones (Ferren and Schuyler 1980).

In freshwater tidal marshes, Sipple (1978) reports three Maryland populations (in Kent, Queen Anne's, and Talbot counties) of *C. brevifolius* that may actually be *C. brevifolioides*. *Cyperus brevifolius* is a species for which *C. brevifolioides* is often mistaken and some authors treat them as conspecific (Delahoussaye and Thieret 1967). Our first collection is probably a new Cecil County record of *C. brevifolioides*. Discovered in Delaware in a tidal habitat in New Castle County in 1983 (Naczi 1984), the above-cited Delaware specimen is the second Delaware collection. This sedge is probably adventive from eastern Asia and spreading (Ferren and Schuyler 1980; Webb and Dennis 1981).

10. Cyperus engelmannii (rare: DE, VA)

DELAWARE: Kent County: SW of Frederica, pond shore, 25 Sep 1984, DOV12265, DOV12266; Garrisons Lake, pond shore, 24 Oct 1984, DOV12718.

Tatnall (1946) records only two collections of this sedge, one in New Castle County, Delaware (1896), and another in Northampton County, Virginia (1935). These Kent County collections appear to be new county records and only the third and fourth DelMarVa collections.

11. Eleocharis tricostata (rare: DE, MD1, MD2, VA)

DELAWARE: Sussex County: W of Portsville, sandy peaty ditch, 21 Jul 1984, DOV12337.

A small population of *E. tricostata* grew in a moist, partially shaded, shallow ditch with *E. engelmannii, E. melanocarpa* (rare: DE, MD2, VA), and *Scirpus cyperinus*. Shreve (1910) records a Caroline County, Maryland, collection of *E. tricostata,* and Tatnall (1946) records a 1908 Sussex County collection.

12. Fimbristylis annua (rare: DE)

MARYLAND: Cecil County: N of Conowingo, slightly moist soil overlying a serpentine outcrop, 29 Aug 1984, DOV12521.

In this sunny location, *F. annua* was scattered but frequent in a thin layer of soil. *Cyperus aristatus* and *Scleria pauciflora* were associated. Tatnall (1946) records this species on serpentine from New Castle County, Delaware, and from Wicomico County, Maryland, and comments, "no recent collections." Our collection is apparently a new county record, even though Pennell (1933) records it on serpentine in nearby Chester County, Pennsylvania, and suggests that it is "doubtless in adjacent Maryland."

13. **Fimbristylis perpusilla** (rare: USA, MD2)

MARYLAND: Queen Anne's County: N of Templeville, shrubby depression in swampy woods, 30 Jul 1985, DOV12164.

About thirty plants of this diminutive sedge were growing in small patches of sunny, bare, moist mud in a DelMarVa Bay. A very few plants of *Cyperus* sp. (immature), *F. autumnalis,* and *Lindernia dubia* var. *anagallidea* grew with *F. perpusilla* in these mud patches. *Carex gigantea* (rare: MD1, MD2), *Cephalanthus occidentalis, Dulichium arundinaceum,* and *Scirpus cyperinus* were abundant in the Bay. Discovered in 1974 on the Peninsula in Caroline County, Maryland, *F. perpusilla* reaches its northern range limit on DelMarVa (Hirst 1983).

14. **Psilocarya scirpoides** (rare: DE, MD1, MD2, VA)

DELAWARE: Kent County: Sandtown, bare mud bottom of natural pond, 30 Jul 1985, DOV12672.

A luxuriant growth of shin-high bald rushes covered the sunny, exposed, moist bottom of this open DelMarVa Bay ringed with *Carex walteriana* (rare: VA), *Dulichium arundinaceum, Panicum hemitomon* (rare: DE, MD1, VA), and *Rhynchospora macrostachya.* When visited on 15 Sep 1984, the pond was dry, but no *Psilocarya* plants were observed. Recently collected in Sussex County, Delaware (Naczi 1984), and reported from Caroline County, Maryland (Sipple and Klockner 1984), this is the second Kent County, Delaware, record and only the fourth Delaware station for *P. scirpoides* (DOV, PH).

15. **Rhynchospora corniculata** var. **corniculata** (rare DE, MD2)

DELAWARE: New Castle County: SW of McKays Corners, swampy woods, 22 Jul 1985, DOV12475.

Nearly twenty clumps of this striking beak rush, each with several fertile culms, were growing in sunny openings in swampy woods in the region in which DelMarVa Bays are common. The area was characterized by *Acer rubrum, Nyssa sylvatica,* and *Liquidambar styraciflua. Carex gigantea* (rare: MD1, MD2), *C. intumescens, C. lupuliformis* (rare: DE, VA), *C. lupulina,* and *Scirpus cyperinus* also occurred. This locality is the same as or very near Canby's 1898 station (Tatnall 1946). There are additional DelMarVa records from Sussex County, Delaware, and Worcester County, Maryland (Tatnall 1946), and a report from Somerset County, Maryland (James L. Stasz, pers. comm. 1984). Because Delaware is the northern limit of *R. corniculata* (Fernald 1970), our collection appears to be the northernmost in the United States.

16. **Rhynchospora globularis** var. **globularis** (rare: MD2)

DELAWARE: Kent County: S of Woodside, moist sandy soil, 11 Aug 1985, DOV12680.

Only sixteen fertile culms of this beak rush were observed. They were growing with *Aletris farinosa, Drosera intermedia, Polygala cruciata* (rare: MD2), *P. mariana, R. capitellata,* and *Spiranthes lacera* var. *gracilis* in this sunny habitat. This species was collected at only four other Delaware stations (PH), the last over a century ago (1876 in Kent County). It is known from three Maryland stations, the last collection in 1972 in Worcester County (William S. Sipple, pers. comm. 1984; James L. Stasz, pers. comm. 1984). *Rhynchospora globularis* is certainly rarer than Tatnall's "infrequent" label suggests.

17. Rhynchospora microcephala (rare: DE, MD2)

DELAWARE: Sussex County: Dagsboro, moist sandy soil, 27 Oct 1984, DOV12703; W of Frankford, moist sandy soil, 20 Aug 1985, DOV12700.

At each locality, *R. microcephala* was abundant in sunny soil and grew with *Juncus canadensis, Polygala lutea,* and *R. capitellata.* Also growing with *R. microcephala* at the first station were *Carex walteriana* (rare: VA), *Lycopodium alopecuroides, P. nuttallii,* and *R. chalarocephala* (rare: DE). At the second station *Bartonia virginica, Eriophorum virginicum,* and *Eupatorium leucolepis* (rare: MD2) were found. Our collections are evidently the second and third of *R. microcephala* in Delaware, the first being in 1907 in Sussex County (Tatnall 1946). In Maryland, this beak rush is recorded from Wicomico County (Tatnall 1946) and was recently found in Worcester County (James L. Stasz, pers. comm. 1984).

18. Rhynchospora torreyana (rare: DE, MD2)

DELAWARE: Sussex County: N of Laurel, sunny swale, 29 Sep 1984, DOV12704.

We observed only one plant bearing four fertile culms of this beak rush. It was growing with *Aristida dichotoma* and *A. virgata* (rare: DE). *Carex walteriana* (rare: VA), *Hedyotis uniflora* (rare: DE, MD2), *Polygala cruciata* (rare: MD2), *R. capitellata,* and *Scirpus cyperinus* were also present in the moist, sandy soil. *Rhynchospora torreyana* is recorded from Kent and Sussex counties, Delaware, and from Wicomico and Worcester counties, Maryland (Gale 1944; Tatnall 1946). It was last collected in Delaware in 1874 (PH).

19. Scirpus cylindricus (rare: MD2)

MARYLAND: Dorchester County: W of Sharptown, high, peaty, slightly brackish tidal marsh along Marshyhope Creek, 19 Jul 1984, DOV12452; Cecil County: S of Cayots, in full sun on sandy mud in brackish tidal marsh along Bohemia River, 6 Aug 1984, DOV12705.

Scirpus cylindricus is a tuberous, leafy bulrush of brackish tidal marshes (Schuyler 1975). At each of the collection sites, it was common and grew with *Zizania aquatica.* In addition, at the more species-rich second locality, this bulrush grew with *Hibiscus moscheutos, Lilaeopsis chinensis, Lobelia cardinalis, Sagittaria calycina* (rare: DE, MD1, MD2, VA), *S. latifolia, S. subulata* (rare: DE), *Scirpus pungens,* and *S. tabernaemontanii.* Rarely collected locally until recently (Ferren and Schuyler 1980), *S. cylindricus* has been collected several times in Delaware but apparently only three times in eastern Maryland. Our collections are new county records (Schuyler 1975).

20. Scirpus expansus (rare: DE)

MARYLAND: Cecil County: SW of Fair Hill, marsh bordering Little Elk Creek, 1 Aug 1985, DOV12505. DELAWARE: New Castle County: Granogue, marsh bordering Brandywine Creek, 17 Aug 1985, DOV12706.

This bulrush was common (over one hundred fertile culms) in each of its sunny streamside marsh habitats. Associates present at each site were *Carex stricta, Impatiens capensis, Mimulus ringens, Onoclea sensibilis, Polygonum sagittatum, Sagittaria latifolia, Scirpus cyperinus,* and *Verbena hastata.* In addition, at the first site, *Glyceria canadensis* (rare: DE) and *Scirpus tabernaemontanii* grew with *S. expansus. Sparganium eurycarpum* dominated the marsh at the second site. Tatnall (1946) notes that this species is "not often collected." Indeed, only two Cecil County collections (last in 1932) and two New Castle County collections (last in 1896) comprise the previous DelMarVa records of this bulrush (Tatnall 1946), although its range is from Maine to Georgia (Schuyler 1967).

21. Scirpus polyphyllus

MARYLAND: Cecil County: Chesapeake City, sunny edge of fresh or slightly brackish tidal marsh along Long Creek, 8 Aug 1985, DOV12707. DELAWARE: New Castle County: N of Newark, partially shaded, wet opening in woods, 15 Aug 1985, DOV12679.

Each *S. polyphyllus* population consisted of only a single patch of several clumps. In addition we observed a small, sterile population on a shaded, moist floodplain of the Brandywine Creek (New Castle County). There are two historic DelMarVa stations of *S. polyphyllus* in New Castle County (last 1896, DOV), one in Cecil County (1909, PH), and three in Talbot County, Maryland (last 1941, PH). Evidently, this bulrush is rarer on DelMarVa than Tatnall's "infrequent" designation indicates. The species ranges from Massachusetts to Illinois, south to Georgia and Alabama (Schuyler 1967).

22. Scirpus smithii var. setosus (rare: DE, MD2)

DELAWARE: Kent County–Sussex County border: W of Milford, in full sun, shallow water of pond, 18 Sep 1984, DOV12708.

Scirpus smithii has previously been collected only three times on DelMarVa: twice in New Castle County (vars. *setosus* and *smithii*) and once in Sussex County (var. *setosus*), Delaware (Long 1910; Tatnall 1946). The 1908 Sussex County station is near the site indicated above, and these localities are at or near the southern limit of the range of this small bulrush (Fernald 1970). *Fuirena pumila* (rare: MD2) was growing in the same clump.

23. Scirpus verecundus (rare: MD2)

DELAWARE: New Castle County: N of Rockland, shady wooded slope, 25 May 1984, DOV12304.

Dense tufts of this dry habitat *Scirpus* were common within a small area on a barren rocky hillside woods of *Fagus grandifolia* and *Quercus* species. Except for one 1886 Queen Anne's County, Maryland, collection (Beetle 1941), all previous DelMarVa collections are from the Brandywine and Red Clay Creek valleys of New Castle County, with the last in 1924 (PH).

RARE PLANT HABITATS

Rare plant habitats are unusually vulnerable to human activity. On the DelMarVa Peninsula, Piedmont habitats have been especially impacted by destruction for development of industry, houses, businesses, and roads. These developmental impacts are generally less adverse on much of the Coastal Plain except for resort areas. However, agricultural drainage—particularly in soils draining to the Chesapeake Bay (about four-fifths of the Peninsula)—may impact wet areas of special importance as rare plant habitats.

Indeed, of all the characteristics noted for the 23 taxa reported here, only one taxon (*Scirpus verecundus*) is listed for a dry habitat. Five taxa are listed for depressions or swales, 2 for ditches, 5 for DelMarVa Bays, 4 for ponds or pond margins, 4 for floodplains, 1 for streams, 6 for swamps or "swampy" areas, 3 for marshes, 2 for flooded sites, and 4 for mud. Almost all of the species are found in freshwater habitats. Five are noted for sandy soils, 2 for peaty soils, and 2 for serpentine.

Eight of the 23 taxa are listed for wooded habitats. However, 19 of the sedges are found in sunny habitats, 9 are found in shade, and 6 are found in both sunny and shady habitats (exposure data for only 22 taxa were recorded in the field). Two sedges are found in logged-over sites and one in a sometimes mowed site. Open areas—even in wooded locations—and disturbance appear to be important habitat factors. Our experience on DelMarVa indicates that, *within limits,* disturbance is a beneficial factor for *some* rare species and is undoubtedly related to successional development of various vegetation patterns.

The correlation of these 23 sedges and their habitats with other rare taxa is significant: 61% (14 of the 23 sedges) are found in association with other taxa variously listed as "rare" in state and national reports. Clearly sedges should be an important segment of concern for the conservation of rare plants. They are not only of interest as individual taxa but also as indicators of special habitats worthy of our protection.

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Bartonia No. 52: 58–59, 1986

Overlooked Plant Specimens Cited by William Darlington in His Floras of Chester County, Pennsylvania

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The following rare plants were cited by William Darlington in his floras of Chester County (1837 or 1853) but not listed in the *Atlas of the Flora of Pennsylvania* by Wherry, Fogg, and Wahl (1979), and listed for the most part in Hugh Stone's *Flora of Chester County* (1945) as "no specimen preserved," or not at all. I have relocated and verified these specimens as to species and locality in the Darlington Herbarium at West Chester University. The labels quoted below follow nearly word for word Darlington's citations in his floras. Species names follow the *Atlas;* when differing, Darlington's species names follow in parentheses. The year of collection immediately follows the species name.

Arethusa bulbosa, 1852, E. Nottingham, Evan Pugh (in Stone's *Flora*); *Asclepias rubra,* 1830, North Valley Hill, near Brook Run, David Townsend (in Stone's *Flora*); *Bupleureum rotundifolium,* 1827, Naturalized about gardens in several neighborhoods, West Chester, Wm. Darlington; *Coeloglossum viride* v. *bracteatum* (*Platanthera bracteata*), 1833, Great Valley, George W. Hall; *Corallorhiza trifida* v. *verna* (*C. innata*), 1831, Black Rock, David Townsend; *Descurainia pinnata,* 1836, Black Rock, Wm. Darlington; *Galactia regularis* (*G. glabella*), 1829, Valley Hill, N. of J. R. Thomas's, Wm. Darlington; *Gaylussacia dumosa,* 1852, Sandy woodlands, West Nottingham, Nathan Milner; *Geum rivale,* 1835, Baldwin's meadow, opposite Friend's Meeting House, Downingtown at last spring of Parke's Run, Wm. Darlington; *Hedyotis purpurea* v. *longifolia* (*H. longifolia*), 1836, Chestnut Hill, Chester County, Joseph Rhinehart; *Hybanthus concolor* (*Solea concolor*), 1841, Red Clay Creek, John M'minn; *Leucothoe racemosa* (*Andromeda racemosa*), 1829, North Valley Hill, N of Remington's & Jacob's, Joshua Hoopes; *Liatris scariosa* v. *scariosa,* 1852, East Nottingham, Evan Pugh; *Lippia lanceolata* v. *recognita,* 1836, Coventry township, Joseph Rhinehart; *Lithospermum canescens,* 1832, Great Valley, Brooke's Mill, G. H. Hall (in Stone's *Flora*); *Lycopodium inundatum,* 1830, New London, Vincent Barnard; *Lysimachia lanceolata,* 1836, Coventry, Chester County, Joseph Rhinehart (in Stone's *Flora*); *Marrubium vulgare,* no date, West Chester, Wm. Darlington; *Najas flexilis,* 1835, Joshua Hoopes (in Stone's *Flora*); *Ophioglossum vulgatum* v. *pseudopodum,* 1829, Jos. Ashbriges, Geo. W. Hall; *Parthenium hysterophorus,* 1857, Near West Chester, Benjamin Shoemaker; *Physostegia virginiana* v. *granulosa,* 1836, Schuylkill, Joseph Rhinehart; *Platanthera peramoena,* 1836, Pigeon Creek, Joseph Rhinehart; *Polygala incarnata,* 1851, E. Nottingham, near Md. line, Evan Pugh; *Polymnia uvedalia,* 1836, Near Warren, Great Valley, Joshua Hoopes; *Pontederia cordata,* 1829, Black Rock, Jn. Marshall; *Populus heterophylla,* 1831, E. Marlborough, Wm. Darlington; *Samolus parviflorus,* 1830, Great Valley near Baptist Meeting House, Rich Walker's meadow, Joseph Rhinehart; *Scutellaria nervosa,* 1829, Black Rock, David Townsend (in Stone's *Flora*); *Sium suave,* 1835, Brandywine, William Darlington; *Smilacina stellata,* 1830, N. Sharpless, Downingtown, Joshua Hoopes (in Stone's Flora); *Solidago speciosa,* 1830, Black Rock, David Townsend, 1833, Black Rock, Wm. Darlington; *Ranunculus* *pusillus,* 1831, Near French Creek bridge, Pikeland, David Townsend; *Ranunculus reptans* v. *reptans,* 1836, Schuylkill, Joseph Rhinehart; *Rychnospora alba,* 1828, George Meredith's, David Townsend; *Triosteum angustifolium,* 1852, E. Nottingham, Evan Pugh; *Veronica scutellata,* 1829, George Meredith's, William Darlington (in Stone's *Flora*); *Woodsia ilvensis,* 1829, Black Rock, David Townsend.

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Bartonia No. 52: 60–77, 1986

Checklist of the Flora of Chester County, Pennsylvania

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The named entities included herein are 71 ferns and fern allies, 13 gymnosperms, 463 monocots, and 1211 dicots for a total of 1758. Distributional notes are based on information from William Darlington's *Flora Cestrica*, ed. II (1837) and ed. III (1853), Hugh E. Stone's *Flora of Chester County* (1945), Edgar T. Wherry et al. *Atlas of the Flora of Pennsylvania* (1979), and field work by William R. Overlease (1963–1984). An asterisk before a name indicates that the plant is an introduction to Chester County. Parentheses enclosing a name indicate that the plant was reported or claimed for Chester County by either Darlington or Stone, but there is no known voucher specimen. Nomenclature follows that of the *Atlas*.

I thank Jack Holt for his interest, many helpful suggestions, and excellent typing, and Ann Rhoads for checking many questionable locality records at the edges of the county with the file of *Atlas* maps at the Morris Arboretum.

PTERIDOPHYTES

LYCOPODIACEAE: *Lycopodium clavatum* v. *clavatum*, rare; *Lycopodium flabelliforme*, frequent; *Lycopodium inundatum*, extirpated; *Lycopodium lucidulum*, frequent; *Lycopodium obscurum* v. *obscurum*, frequent; *Lycopodium obscurum* v. *dendroideum*, four stations; *Lycopodium tristachyum*, rare.

SELAGINELLACEAE: *Selaginella apoda*, frequent; *Selaginella rupestris*, rare.

ISOETACEAE: *Isoetes engelmannii*, rare.

EQUISETACEAE: *Equisetum arvense* (incl. forms), common; *Equisetum fluviatile*, rare; *Equisetum hyemale* (incl. vars.), frequent; *Equisetum sylvaticum* (incl. vars.), rather rare.

OPHIOGLOSSACEAE: *Botrychium dissectum* v. *dissectum*, frequent; *Botrychium lanceolatum* v. *angustisegmentum*, rare; *Botrychium matricariaefolium*, rare; *Botrychium obliquum*, frequent; *Botrychium virginianum*, common; *Ophioglossum vulgatum* v. *pycnostichum*, very rare; *Ophioglossum vulgatum* v. *pseudopodum*, rare.

OSMUNDACEAE: *Osmunda cinnamomea* v. *cinnamomea*, common; *Osmunda claytoniana*, frequent; *Osmunda regalis* v. *spectabilis*, frequent.

POLYPODIACEAE: *Adiantum pedatum*, common; *Adiantum pedatum* (serpentine form), one station; *Asplenium × ebenoides*, rare; *Asplenium montanum*, rare; *Asplenium pinnatifidum*, rare; *Asplenium platyneuron*, common; *Asplenium platyneuron* v. *incisum*, one station; *Asplenium ruta-muraria* v. *ruta-muraria*, extirpated; *Asplenium trichomanes*, rather rare; *Asplenium × trudellii*, rare; *Athyrium angustum* v. *elatius*, frequent; *Athyrium angustum* v. *rubellum*, common; *Athyrium asplenioides* v. *asplenioides*, common; *Athyrium pycnocarpon*, one station; *Athyrium thelypterioides*, frequent; *Camptosorus rhizophyllus*, rather rare; *Cheilanthes lanosa*, rare; *Cystopteris bulbifera*, very rare; *Cystopteris fragilis* v. *mackayi*, frequent; *Cystopteris protrusa*, two stations; *Dennstaedtia punctilobula*, common; *Dryopteris × boottii*, four stations; *Dryopteris carthusiana*, occasional; *Dryopteris celsa × cristata*, one station; *Dryopteris clintoniana*, rare; *Dryopteris cristata*, frequent; *Dryopteris goldiana*, rare; *Dryopteris intermedia*, common; *Dryopteris marginalis*, common; *Dryop-*

teris × *slossonae*, three stations; *Dryopteris* × *triploidea*, eight stations; *Dryopteris* × *uliginosa*, one station; *Onoclea sensibilis*, common; *Onoclea sensibilis* f. *obtusilobata*, two stations; *Pellaea atropurpurea*, rather rare; *Pellaea glabella*, rare; *Phegopteris hexagonoptera*, common; *Polypodium virginianum* (incl. forms), common; *Polystichum acrostichoides*, common; *Pteridium aquilinum* v. *latiusculum*, common; *Thelypteris noveboracensis*, common; *Thelypteris palustris* v. *pubescens*, frequent; *Thelypteris palustris* v. *haleana*, one station; *Woodsia ilvensis*, extirpated; *Woodsia obtusa*, rather rare; *Woodwardia areolata*, rare.

*MARSILEACEAE: *Marsilia quadriflora*, rare.

SPERMATOPHYTES

PINACEAE: **Cedrus libani*, one station; **Pinus nigra*, one station; *Pinus pungens*, rare; *Pinus rigida*, rare; *Pinus strobus*, rare; **Pinus sylvestris*, one station; *Pinus virginiana*, rather rare; *Tsuga canadensis*, frequent.

CUPRESSACEAE: **Juniperus communis*, rare; *Juniperus virginiana*, frequent; **Thuja occidentalis*, one station.

TAXACEAE: *Taxus canadensis*, extirpated; **Taxus cuspidata*, one station.

TYPHACEAE: *Typha angustifolia*, rather rare; *Typha latifolia*, common.

SPARGANIACEAE: *Sparganium americanum*, *rather* rare; *Sparganium chlorocarpum*, extirpated; *Sparganium eurycarpum*, rare.

NAJADACEAE: *Najas flexilis*, one station.

ZOSTERACEAE: *Potamogeton amplifolius*, rare; *Potamogeton berchtoldii* v. *lacunatus*, one station; **Potamogeton crispus*, rare; *Potamogeton diversifolius*, rare; *Potamogeton epihydrus* v. *nuttallii*, rather rare; *Potamogeton foliosus* v. *macellus*, probably frequent; *Potamogeton illinoensis*, two stations; *Potamogeton nodosus*, two stations; *Potamogeton pectinatus*, Schuylkill River; *Zannichellia palustris* v. *major*, rare.

ALISMATACEAE: *Alisma subcordatum*, frequent; *Sagittaria australis*, frequent; *Sagittaria latifolia* v. *latifolia* (incl. forms), frequent; *Sagittaria latifolia* v. *pubescens*, seven stations; *Sagittaria rigida*, rare.

HYDROCHARITACEAE: *Elodea canadensis*, one station; *Elodea nuttallii*, rather rare; *Vallisneria americana* Michx. rather rare.

GRAMINEAE: **Aegilops triuncialis*, one station; **Agropyron repens*, frequent; **Agrostis alba*, common; *Agrostis hyemalis*, rather rare; **Agrostis palustris*, one station; *Agrostis perennans* (incl. vars.), frequent; *Agrostis scabra*, one station; *Alopecurus aequalis*, two stations; **Alopecurus pratensis*, one station; *Andropogon elliottii*, rare; *Andropogon gerardii*, rather rare; *Andropogon glomeratus*, rather rare; *Andropogon scoparius* v. *scoparius*, frequent; *Andropogon virginicus*, common; **Anthoxanthum odoratum*, common; *Aristida dichotoma* (incl. f. *major*), frequent; *Aristida longespica*, common; *Aristida longespica* v. *geniculata* two stations; *Aristida oligantha*, rare; *Aristida purpurascens*, rather rare; **Arrhenatherum elatius*, frequent; **Arthraxon hispidus* v. *cryptatherus*, one station; **Avena sativa*, one station; *Bouteloua curtipendula*, rare; *Brachyelytrum erectum* v. *erectum*, frequent; *Brachyelytrum erectum* v. *septentrionale*, one station; **Bromus commutatus*, common; **Bromus inermis*, rare; **Bromus japonicus* v. *porrectus*, five stations; **Bromus mollis*, one station; *Bromus pubescens* (incl. forms), frequent; *Bromus purgans*, frequent; **Bromus secalinus*, rare; **Bromus sterilis*, rare; **Bromus tectorum*, rare; *Calamagrostis canadensis*, rare; *Calamagrostis cinnoides*, rather rare; **Cenchrus pauciflorus*, rare; *Cinna* *arundinacea*, frequent; **Cynodon dactylon*, rare; **Dactylis glomerata*, common; *Danthonia compressa*, rather rare; *Danthonia spicata* (incl. v. *longipila*) frequent; *Deschampsia caespitosa* v. *glauca*, very local; *Deschampsia flexuosa*, rare; *Digitaria filliformis*, frequent; *Digitaria ischaemum*, frequent; **Digitaria sanguinalis*, common; **Echinochloa crusgalli*, frequent; *Echinochloa pungens* (incl. vars.), rare; **Eleusine indica*, common; *Elymus canadensis* (incl. f. *glaucifolius*), rare; *Elymus riparius*, frequent; *Elymus villosus*, frequent; *Elymus villosus* f. *arkansanus*, one station; *Elymus virginicus* v. *virginicus*, rather rare; *Elymus virginicus* f. *hirsutiglumis*, rare; *Eragrostis capillaris*, rather rare; **Eragrostis cilianensis*, rather rare; *Eragrostis frankii*, rather rare; *Eragrostis hypnoides*, rare; **Eragrostis multicaulis*, one station; *Eragrostis pectinacea*, very common; **Eragrostis pilosa*, rare; *Eragrostis poaeoides*, rare; *Eragrostis spectabilis* (incl. f. *sparsihirsuta*), common; *Erianthus saccharoides*, rare; *Festuca capillata*, rare; *Festuca obtusa*, frequent; *Festuca octoflora* v. *tenella*, frequent; *Festuca ovina* v. *ovina*, rather rare; *Festuca paradoxa*, one station; **Festuca pratensis* (incl. vars.), common; **Festuca rubra* (incl. vars.), rare; *Glyceria canadensis* v. *canadensis*, rare; *Glyceria canadensis* v. *laxa*, two stations; *Glyceria melicaria*, rather rare; *Glyceria septentrionalis*, rather rare; *Glyceria striata*, common; **Heleochloa schoenoides*, rare; **Holcus lanatus*, frequent; *Hordeum jubatum*, rare; **Hordeum leporinum*, one station; *Hystrix patula* v. *patula*, frequent; *Hystrix patula* v. *bigeloviana*, one station; *Leersia oryzoides*, frequent; *Leersia virginica*, frequent; *Leptoloma cognatum*, one station; **Lolium multiflorum*, rare; **Lolium perenne*, common; **Lolium temulentum*, one station; **Microstegium vimineum*, very common; **Miscanthus sinensis*, rare; *Muhlenbergia frondosa*, common; *Muhlenbergia glomerata* (incl. vars.), rare; *Muhlenbergia mexicana*, frequent; *Muhlenbergia schreberi*, common; *Muhlenbergia sobolifera*, frequent; *Muhlenbergia sylvatica* (incl. v. *robusta*), frequent; *Muhlenbergia tenuiflora*, frequent; *Oryzopsis racemosa*, extirpated; *Panicum agrostoides*, frequent; *Panicum anceps*, frequent; *Panicum annulum*, rare; *Panicum bicknellii*, one station; *Panicum boscii* v. *boscii*, frequent; *Panicum boscii* v. *molle*, six stations; *Panicum capillare* v. *capillare* common; *Panicum capillare* v. *occidentale*, five stations; *Panicum clandestinum*, frequent; *Panicum columbianum*, rather rare; *Panicum commutatum* v. *commutatum*, rather rare; *Panicum commutatum* v. *ashei*, frequent; *Panicum depauperatum* v. *depauperatum*, frequent; *Panicum depauperatum* v. *psilophyllum*, six stations; *Panicum dichotomiflorum* (incl. v. *geniculatum*), locally common; *Panicum dichotomum* (incl. v. *barbulatum*), common; *Panicum flexile*, rather rare; *Panicum gattingeri*, frequent; *Panicum implicatum* (incl. *P. languginosum* and *P. tennesseense* of Stone's Flora), common; *Panicum latifolium*, rather rare; *Panicum lindheimeri*, rare; *Panicum linearifolium* v. *linearifolium*, rather rare; *Panicum linearifolium* v. *werneri*, rare; *Panicum lucidum*, rare; *Panicum meridionale*, rare; *Panicum microcarpon*, frequent; *Panicum philadelphicum*, frequent; *Panicum polyanthes*, rather rare; *Panicum recognitum*, one station; *Panicum scoparium*, one station; *Panicum scribnerianum*, locally frequent; *Panicum sphaerocarpon*, locally frequent; *Panicum stipitatum*, one station; *Panicum villosissimum*, frequent; *Panicum virgatum* (incl. vars.), rather rare (mostly introduced); *Panicum yadkinense*, apparently rare; *Papsalum laeve* v. *laeve*, frequent; *Papsalum laeve* v. *circulare*, frequent; *Papsalum pubescens*, frequent; **Pennisetum alopecuroides*, one station; *Phalaris arundinacea*, common; *Phalaris arundinacea* f. *variegata*, one station; **Phalaris canariensis*, rare; **Phelum pratense*, common; *Phragmites australis*, frequent (mostly introduced); *Poa annua*, common; **Poa compressa*, common; *Poa cuspidata*, rather rare; *Poa paludi-*

gena, one station; **Poa palustris*, one station; *Poa pratensis*, common; *Poa sylvestris*, rather rare; **Poa trivialis*, frequent; **Secale cereale*, one station; **Setaria faberi*, common; **Setaria faberi* (glabrous form), two stations; *Setaria geniculata*, locally frequent; **Setaria italica*, one station; **Setaria lutescens*, common; *Setaria verticillata*, rather rare; *Setaria viridis*, locally frequent; *Sorghastrum nutans*, locally frequent; **Sorgum halepense*, occasional; **Sorgum sudanense*, one station; *Spartina pectinata* (incl. vars.), extirpated; *Sphenopholis intermedia*, rather rare; *Sphenopholis nitida*, frequent; *Sphenopholis obtusata* v. *obtusata*, three stations; *Sphenopholis obtusata* v. *pubescens*, rare; *Sphenopholis pallens*, frequent; *Sporobolus heterolepis*, one station; *Sporobolus neglectus*, one station; *Sporobolus vaginiflorus* (incl. v. *inaequalis*), frequent; *Sphenopholis obtusata* v. *obtusata*, three stations; *Sphenopholis obtusata flavus* (yellow f.), one station; *Tripsacum dactyloides*, one station; *Trisetum pensylvanicum*, rather rare; *Triticum aestivum*, one station; *Uniola latifolia*, rare; *Zea mays*, three stations; *Zizania aquatica*, rare.

CYPERACEAE: *Bulbostylis capillaris* (incl. v. *crebra*), rare; *Carex abdita*, seven stations; *Carex abscondita*, rare; *Carex aggregata*, frequent; *Carex albolutescens*, three stations; *Carex amphibola* v. *rigida*, eight stations; *Carex amphibola* v. *turgida*, common; *Carex angustior*, three stations; *Carex annectens* v. *annectens*, seven stations; *Carex annectens* v. *xanthocarpa*, common; *Carex argyrantha*, one station; *Carex artitecta, eight stations; Carex bicknellii*, locally abundant (only on serpentine); *Carex blanda*, common; *Carex brevior*, probably frequent; *Carex bromoides*, rather rare; *Carex bullata*, rare; *Carex bushii*, rare; *Carex caroliniana*, rare; *Carex cephalophora*, frequent; (*Carex collinsii*, *C. subulata* in Flora Cestrica, claimed by Darlington, no known specimen;) *Carex communis*, rather rare; *Carex comosa*, rare; *Carex conjuncta*, rare; *Carex conoidea*, rare; *Carex convoluta*, frequent; *Carex crinita*, frequent; *Carex cristatella*, rather rare; *Carex davisii*, rare; *Carex debilis* v. *debillis*, frequent; *Carex debilis* v. *rudgei*, rare; *Carex digitalis*, frequent; *Carex emmonsii*, rather rare; *Carex emoryi*, rare; *Carex festucacea*, common; *Carex folliculata*, rare; *Carex frankii*, rare; *Carex glaucodea*, frequent; *Carex gracilescens*, rather rare; *Carex gracillima*, frequent; *Carex granularis* v. *granularis*, frequent; *Carex granularis* v. *haleana*, two stations; *Carex grayii* v. *hispidula*, rare; *Carex gynandra*, frequent; *Carex hirsutella*, frequent; *Carex hirtifolia*, frequent; *Carex howei*, rare; *Carex hystricina*, frequent; *Carex incomperta*, frequent; *Carex interior*, rare; *Carex intumescens* v. *intumescens*, frequent; *Carex jamesii*, rare; *Carex laevivaginata*, fairly frequent; *Carex lanuginosa*, rather rare; *Carex laxiculmis*, frequent; *Carex laxiflora* (incl. v. *serrulata)*, frequent; *Carex leavenworthii*, one station; *Carex leptalea* v. *leptalea*, frequent; *Carex lupulina* (incl. v. *pedunculata*), rare; *Carex lurida*, common; *Carex meadii*, one station; *Carex modesta*, five stations; *Carex muhlenbergii*, frequent; *Carex nigromarginata* (incl. *C. albicans*), frequent; *Carex normalis*, common; *Carex oligocarpa*, rare; *Carex pedunculata*, rare; *Carex pensylvanica* v. *pensylvanica*, frequent; *Carex pensylvanica* v. *distans*, three stations; *Carex plana*, two stations; *Carex plantaginea*, extirpated; *Carex platyphylla*, rare; *Carex polymorpha*, rare; *Carex prasina*, frequent; *Carex retroflexa*, rare; *Carex rosea*, frequent; *Carex scabrata*, rather rare; *Carex scoparia* (incl. forms), common; *Carex seorsa*, rather rare; *Carex sparganioides*, rather frequent; **Carex spicata*, rare; *Carex squarrosa*, frequent; *Carex stipata*, common; *Carex straminea*, rare; *Carex striatula*, three stations; *Carex stricta*, common; *Carex strictior*, rare; *Carex styloflexa*, rather rare; *Carex swanii*, frequent; *Carex tonsa*, rather rare; *Carex torta*, rather rare; *Carex tribuloides*, frequent; *Carex* *trichocarpa,* rare; *Carex umbellata,* rather rare; *Carex vestita,* rather rare; *Carex virescens,* rather rare; *Carex vulpinoidea,* frequent; *Carex willidenovii,* rather rare; *Cyperus aristatus,* rare; *Cyperus erythrorhizos,* one station; *Cyperus esculentus,* L. rather rare; *Cyperus filiculmis* (incl. v. *macilentus*), frequent; *Cyperus flavescens,* rare; *Cyperus odoratus,* one station; *Cyperus ovularis,* one station; (*Cyperus retrofractus* claimed by Darlington, no known specimen for Chester County or Pennsylvania;) *Cyperus rivularis,* frequent; *Cyperus strigosus,* common; *Dulichium arundinaceum,* frequent; *Eleocharis acicularis,* frequent; *Eleocharis erythropoda,* rather rare; *Eleocharis engelmannii,* rare; *Eleocharis obtusa,* frequent; *Eleocharis tenuis* v. *tenuis,* rather rare; *Eleocharis tenuis* v. *pseudoptera,* four stations; *Eriophorum tenellum,* rare; *Eriophorum virginicum,* rare; *Fimbristylis autumnalis,* frequent; *Fimbristylis baldwiniana,* locally frequent; *Rychnospora alba,* extirpated; *Rychnospora capitellata,* frequent; *Rychnospora capitellata* f. *controversa,* three stations; *Rychnospora globularis* v. *recognita,* rare; *Scirpus atrovirens* (incl. hybrids), frequent; *Scirpus cyperinus* (incl. vars.), common; *Scirpus expansus,* rather rare; *Scirpus georgianus,* frequent; *Scirpus hattorianus,* four stations; *Scirpus pendulus,* rather rare; *Scirpus polyphyllus,* frequent; *Scirpus pungens,* very rare; *Scirpus purshianus,* rather rare; *Scirpus validus* v. *creber,* frequent; *Scirpus verecundus,* frequent; *Scleria minor,* rare; *Scleria muhlenbergii,* rare; *Scleria pauciflora,* locally common; *Scleria triglomerata,* rather rare.

ARACEAE: *Acorus americanus,* frequent; *Arisaema dracontium,* rather rare; *Arisaema pusillum,* frequent; *Arisaema triphyllum,* common; *Orontium aquaticum,* rare; *Peltandra virginica,* rare; *Symplocarpus foetidus,* common.

LEMNACEAE: *Lemna minor,* common; *Lemna trisulca,* rare; *Spirodela polyrhiza,* two stations.

XYRIDACEAE: *Xyris torta,* rare.

COMMELINACEAE: **Commelina communis,* common; *Tradescantia virginiana,* frequent.

PONTEDERIACEAE: *Heteranthera dubia,* frequent; *Heteranthera reniformis,* frequent; *Pontederia cordata,* extirpated.

JUNCACEAE: *Juncus acuminatus,* frequent; *Juncus biflorus,* rare; *Juncus bufonius,* frequent; *Juncus canadensis,* rare; *Juncus dudleyi,* rare; *Juncus effusus* v. *pylaei, three stations; Juncus effusus* v. *solutus,* common; *Juncus longii,* one station; *Juncus marginatus,* frequent; *Juncus platyphyllus,* rather rare; *Juncus scirpoides,* frequent; *Juncus secundus,* rather rare; *Juncus subcaudatus,* rather rare; *Juncus tenuis,* common; *Luzula bulbosa,* two stations; *Luzula echinata,* eight stations; *Luzula multiflora,* common.

LILIACEAE: *Aletris farinosa,* rather rare; *Allium canadense,* frequent; **Allium oleraceum,* one station; *Allium tricoccum,* rather rare (locally abundant); **Allium vineale,* very common; *Amianthium muscaetoxicum,* frequent; **Asparagus officinalis,* frequent; *Chamaelirium luteum,* frequent; **Convallaria majalis,* one station; *Erythronium americanum,* common; **Hemerocallis fulva* v. *fulva,* frequent; **Hemerocallis fulva* cv. "kwanso" regel, one station; **Hosta ventricosa,* two stations; *Lilium canadense* v. *canadense,* frequent; *Lilium canadense* v. *editorum,* one station; *Lilium philadelphicum,* rather rare; *Lilium superbum,* rare; **Lilium tigrinum,* one station; *Maianthemum canadense,* frequent; *Medeola virginiana* common; *Melanthium hybridum,* rare; *Melanthium virginicum* rare; **Muscari atlanticum,* rare; **Muscari botryoides,* rare; **Ornithogalum nutans,* one station; **Ornithogalum umbellatum,* common; *Polygonatum biflorum,* common; *Polygonatum commutatum,* common; *Polygonatum pu-*

bescens, ten stations; *Smilacina racemosa* v. *racemosa*, four stations; *Smilacina racemosa* v. *cylindrata*, common; *Smilacina stellata*, extirpated; *Smilax glauca* v. *leurophylla*, common; *Smilax herbacea*, frequent; *Smilax hispida*, frequent; *Smilax pulverulenta*, twelve stations; *Smilax rotundifolia*, common; *Trillium cernuum* v. *cernuum*, frequent; *Trillium cernuum* v. *macranthum*, four stations; *Uvularia perfoliata*, frequent; *Uvularia sessilifolia*, frequent; *Veratrum viride* frequent; **Yucca smalliana*, one station.

AMARYLLIDACEAE: *Hypoxis hirsuta*, frequent; **Leucojum aestivum*, two stations.

DIOSCOREACEAE: **Dioscorea batatas*, one station; *Dioscorea villosa* (incl. f. *glabrifolia*), frequent.

IRIDACEAE: **Belamcanda chinensis*, rare; *Iris prismatica*, extirpated; **Iris pseudoacorus*, rather rare; *Iris versicolor*, frequent; *Sisyrinchium angustifolium*, frequent; *Sisyrinchium mucronatum*, frequent.

ORCHIDACEAE: *Aplectrum hyemale*, rare; *Arethusa bulbosa*, extirpated; *Calopogon pulchellus*, very rare; *Coeloglossum viride* v. *bracteatum*, extirpated; *Corallorhiza maculata*, rare; *Corallorhiza odontorhiza*, rather rare; *Corallorhiza trifida* v. *verna*, extirpated; *Corallorhiza wisteriana*, rare; *Cypripedium acaule*, locally common; *Cypripedium calceolus* v. *pubescens*, rare; **Epipactis helleborine*, one station; *Galearis spectabilis*, frequent; *Goodyera pubescens*, frequent; (*Isotria medeoloides*, claimed by Stone, no known specimen;) *Isotria verticillata*, frequent; *Liparis lillifolia*, frequent; *Liparis loeselii*, rare; *Listera australis*, extirpated; *Malaxis unifolia*, rare; *Platanthera ciliaris*, rare; *Platanthera clavellata* (incl. v. *ophioglossoides* (Fern.), not common; *Platanthera flava* v. *herbiola*, not common; *Platanthera grandiflora*, rare; *Platanthera lacera*, not common; *Platanthera orbiculata*, rare; *Platanthera peramoena*, extirpated; *Platanthera psycodes*, rare; *Pogonia ophioglossoides*, rare; *Spiranthes cernua*, frequent; *Spiranthes gracilis*, frequent; *Spiranthes lucida*, very rare; *Spiranthes tuberosa*, rare; (*Spiranthes vernalis*, claimed by Stone, no known specimen;) *Tipularia discolor*, rare; *Triphora trianthophora*, rare.

SAURURACEAE: *Saururus cernuus*, rare.

SALICACEAE: **Populus alba*, rather rare; *Populus deltoides*, one station; **Populus* × *gileadensis*, rare; *Populus grandidentata*, frequent; *Populus heterophylla*, extirpated; *Populus tremuloides*, rare; **Salix alba*, common; *Salix bebbiana*, rather rare; *Salix discolor* v. *discolor*, rather rare; **Salix fragilis*, frequent; *Salix humulis* v. *humilis* (incl. hybrids), frequent; *Salix humilis* v. *rigidiuscula*, two stations; *Salix lucida*, extirpated; *Salix nigra* v. *nigra*, frequent; *Salix nigra* v. *falcata*, one station; *Salix purpurea*, rather rare; *Salix rigida*, two stations; *Salix sericea*, frequent; *Salix tristis* locally frequent.

MYRICACEAE: *Comptonia peregrina*, frequent; *Myrica pensylvanica*, rare.

JUGLANDACEAE: *Carya cordiformis*, frequent; *Carya glabra* (incl. f. *hirsuta*), common; *Carya ovalis* (incl. vars.), one station; *Carya ovata* (incl. vars.), common; *Carya tomentosa*, common; *Juglans cinearea*, frequent; *Juglans nigra*, frequent.

BETULACEAE: *Alnus serrulata*, common; *Betula alba*, one locality; *Betula lenta*, frequent; *Betula lutea* v. *lutea*, rare; *Betula lutea* v. *macrolepis*, one station; *Betula nigra*, rather rare; *Betula populifolia*, rare.

CORYLACEAE: *Carpinus caroliniana* v. *virginiana*, common; *Corylus americana*, frequent; *Corylus cornuta*, rather rare; *Ostrya virginiana* (incl. v. *lasia*), frequent.

FAGACEAE: *Castanea dentata*, frequent (as root sprouts, no mature trees known to have survived the chestnut blight); *Castanea pumila*, rare; *Fagus grandifolia*, (incl.

vars.), common; *Quercus alba,* common; *Quercus bicolor,* frequent; *Quercus coccinea,* common; *Quercus falcata* (incl. v. *tril.*), rare; *Quercus × heterophylla* (*phellos × rubra*), two stations; *Quercus ilicifolia,* frequent; **Quercus imbricaria,* one station; *Quercus × jackiana* (*alba × bicolor*), one station; **Quercus macrocarpa,* one station; *Quercus marilandica,* rare; *Quercus muehlenbergii,* local (on limestone); *Quercus palustris,* frequent; *Quercus prinoides* locally frequent; *Quercus prinus,* common; *Quercus rubra* (incl. v. *borealis*), common; *Quercus stellata,* locally frequent; *Quercus velutina,* common.

ULMACEAE: *Celtis canina,* three stations; *Celtis occidentalis,* v. *occidentalis,* frequent; *Celtis occidentalis* v. *crassifolia,* rather rare; *Celtis tenuifolia,* one station; *Ulmus americana,* rather rare (following Dutch Elm Disease in county); **Ulmus pumila,* one station; *Ulmus rubra,* frequent.

MORACEAE: **Broussonetia papyrifera,* one station; **Maclura pomifera,* frequent; **Morus alba* (incl. red-fruit cultivars), frequent; *Morus rubra,* frequent.

CANNABACEAE: **Cannabis sativa,* rather rare; *Humulus japonicus, frequent; *Humulus lupulinus* (in part introduced), rare.

URTICACEAE: *Boehmeria cylindrica,* frequent; *Laportea canadensis,* frequent; *Parietaria pensylvanica,* frequent; *Pilea pumila,* common; **Urtica dioica,* frequent; *Urtica procera,* rare.

(LORANTHACEAE: *Phoradendron serotinum,* extirpated, "a few specimens yet occur in the southwestern part of the county," Flora Cestrica Ed. II, no specimen known for Chester County.)

SANTALACEAE: *Comandra umbellata,* frequent.

ARISTOLOCHIACEAE: *Aristolochia serpentaria,* rather rare; *Asarum canadense* v. *canadense,* common; *Asarum candense* v. *acuminatum,* three stations; *Asarum canadense* v. *reflexum,* two stations.

POLYGONACEAE: **Fagopyrum esculentum,* occasional; *Polygonum arifolium* v. *pubescens,* common; **Polygonum aviculare* v. *aviculare,* common; **Polygonum aviculare* v. *vegetum,* four stations; **Polygonum caespitosum* v. *longisetum,* common; *Polygonum cilinode,* occasional; *Polygonum coccineum,* rare; **Polygonum convolvulus,* common; *Polygonum cristatum,* rare; **Polygonum cuspidatum,* frequent; *Polygonum erectum,* common; **Polygonum hydropiper,* common; *Polygonum hydropiperoides,* rare; *Polygonum lapathifolium,* rare; **Polygonum orientale,* rare; *Polygonum pensylvanicum* v. *pensylvanicum,* one station; *Polygonum pensylvanicum* v. *laevigatum,* common; **Polygonum perfoliatum,* one station; **Polygonum persicaria* (incl. v. *ruderale*), common; *Polygonum punctatum* v. *confertiflorum,* common; **Polygonum sachalinense,* one station; *Polygonum sagittatum,* common; *Polygonum scandens,* common; *Polygonum tenue,* locally common; **Rumex acetosella,* common; **Rumex altissimus,* rare; **Rumex crispus,* common; **Rumex obtusifolius,* common; *Tovara virginiana* common.

CHENOPODIACEAE: **Atriplex arenaria,* one station; **Chenopodium album* v. *album,* common; **Chenopodium album* v. *lanceolatum,* three stations; **Chenopodium ambrosioides* v. *ambrosioides* (incl. v. *anthelminticum*), common; **Chenopodium botrys,* rare; *Chenopodium gigantosperum,* one station; *Chenopodium missouriense,* ten stations; *Chenopodium standleyanum,* frequent; **Kochia scoparia,* one station.

AMARANTHACEAE: **Amaranthus albus,* five stations; **Amaranthus graecizans,* frequent; **Amaranthus hybridus,* frequent; **Amaranthus powellii,* three stations; **Amaranthus retroflexus,* three stations; **Amaranthus spinosus,* rare; **Amaranthus tamariscinus,* one station; **Froelichia gracilis,* one station.

NYCTAGINEACEAE: **Oxybaphys nyctagineus,* rare.

PHYTOLACCACEAE: *Phytolacca americana,* common.

MOLLUGINACEAE: **Mollugo verticillata,* common.

PORTULACACEAE: *Claytonia virginica,* common; *Claytonia vriginica f. lutea,* one station; **Portulaca grandiflora,* one station; **Portulaca oleracea,* common; *Talinum teretifolium,* rare.

CARYOPHYLLACEAE: **Agrostemma githago,* frequent; **Arenaria serphyllifolia,* frequent; *Arenaria stricta,* rather rare (only on serpentine); *Cerastium arvense* v. *arvense,* rare; *Cerastium arvense* v. *villosum,* locally common (only on serpentine); *Cerastium arvense* v. *villosissimum,* one station, on serpentine; **Cerastium glomeratum,* frequent; **Cerastium holostioides,* common; *Cerastium nutans,* frequent; **Dianthus armeria,* frequent; **Dianthus barbatus,* one station; *Moehringia lateriflora,* rare; **Myosoton aquaticum,* six stations; *Paronychia canadensis,* frequent; *Paronychia fastigiata,* rather rare; *Sagina decumbens,* one station; *Sagina procumbens,* rare; **Saponaria officinalis,* common; **Silene alba,* common; **Silene antirrhina,* common; **Silene dichotoma,* rare; **Silene noctiflora,* rare; *Silene stellata* (incl. vars.), frequent; **Silene vulgaris,* occasional; *Stellaria alsine,* frequent; **Stellaria graminea,* rare; *Stellaria longifolia,* frequent; **Stellaria media* (incl. vars.), common; *Stellaria pubera,* rare; **Vaccaria pyramidata,* rare.

NYMPHAEACEAE: (*Brasenia schreberi,* reported by Darlington, no known specimen;) *Nuphar advena* ssp. *macrophylla,* frequent.

CERATOPHYLLACEAE: *Ceratophyllum demersum,* one station.

RANUNCULACEAE: *Actaea pachypoda,* fairly frequent; *Anemone quinquefolia,* frequent; *Anemone riparia,* one station; *Anemone virginiana* (incl. forms), frequent; *Anemonella thalictroides,* common; *Aquilegia canadensis,* frequent; *Caltha palustris,* rather rare; *Cimicifuga racemosa,* common; *Clematis occidentalis,* rare; *Clematis viorna,* rare; *Clematis virginiana,* frequent; *Coptis groenlandica,* rare; **Delphinium ajacis,* one station; **Eranthus hyemalis,* two stations; *Hepatica americana,* common; *Hydrastis canadensis,* rather rare; *Myosurus minimus,* one station; *Ranunculus abortivus,* common; **Ranunculus acris,* frequent; *Ranunculus ambigens,* rare; **Ranunculus bulbosus,* common; (*Ranunculus fascicularis,* reported by Stone as collected along Octoraro Creek, however, label did not specify Chester County;) **Ranunculus ficaria,* frequent; **Ranunculus ficaria* double form, one station; *Ranunculus hederaceus,* extirpated; *Ranunculus hispidus* f. *falsus,* frequent; *Ranunculus pusillus,* extirpated; *Ranunculus recurvatus,* common; **Ranunculus repens* v. *pleniflorus,* frequent; *Ranunculus reptans* v. *reptans,* extirpated; **Ranunculus scleratus,* frequent; *Ranunculus septentrionalis,* frequent; *Ranunculus trichophyllus* v. *trichophyllus,* rare; *Ranunculus trichophyllus* v. *calvescens,* one station; *Thalictrum dioicum,* frequent; *Thalictrum pubescens,* common; *Thalictrum revoltum,* rare.

LARDIZABALACEAE: **Akebia quinata,* one station.

BERBERIDACEAE: **Berberis thunbergii,* frequent; **Berberis vulgaris,* rare; *Caulophyllum thalictroides,* rather rare; *Podophyllum peltatum,* common; *Podophyllum peltatum* (pink form), one station.

MENISPERMACEAE: *Menispermum canadense,* frequent.

MAGNOLIACEAE: *Liriodendron tulipifera,* common; *Magnolia virginica,* rare.

ANNONACEAE: *Asimina triloba,* rare.

LAURACEAE: *Lindera benzoin,* common; *Sassafras albidum* v. *albidum,* common; *Sassafras albidum* v. *molle,* ten stations.

PAPAVERACEAE: **Chelidonium majus,* frequent; **Macleaya cordata,* one station;

**Papaver dubium,* rather rare; **Papaver rhoeas,* two stations; *Sanguinaria canadensis,* common; **Stylophorum diphyllum,* one station.

Fumariaceae: *Adlumia fungosa,* rare; *Corydalis flavula,* rare; *Corydalis sempervirens,* rare; *Dicentra canadensis,* very rare; *Dicentra cucullaria,* locally common.

Cruciferae: **Alliaria petiolata,* common; **Arabidopsis thaliana,* common; *Arabis canadensis,* frequent, **Arabis glabra,* rare; *Arabis laevigata* v. *laevigata,* frequent; *Arabis lyrata,* locally common; *Arabis patens,* rather rare; **Armoracia rusticana,* rather rare; **Barbarea verna,* rather rare; **Barbarea vulgaris* v. *vulgaris,* common; **Barbarea vulgaris* v. *arcuata,* common; **Brassica campestris* (incl. *B. rapa* & hybrids), common; **Brassica kaber* v. *pinnatifida,* frequent; **Brassica nigra,* two stations; **Camelina microcarpa,* rather rare; **Capsella bursa-pastoris,* common; *Cardamine bulbosa,* frequent; **Cardamine hirsuta,* two stations; **Cardamine impatiens,* rare; *Cardamine parviflora* v. *arenicola,* frequent; *Cardamine pensylvanica,* common; *Cardamine rotundifolia,* rare; **Coronopus procumbens,* one station; *Dentaria laciniata,* frequent; **Descurainia pinnata,* one station; **Descurainia sophia,* one station; **Diplotaxis muralis,* one station; **Draba verna,* rather rare; **Erysimum cheiranthoides,* rare; **Hesperis matronalis,* common; **Lepidium campestre,* common; **Lepidium densiflorum,* eight stations; **Lepidium virginicum,* common; **Lunaria annua,* two stations; **Nasturtium microphyllum,* one station; **Nasturtium officinale,* frequent; **Raphanus raphanistrum,* occasional; **Raphanus sativus,* one station; *Rorippa palustris,* v. *fernaldiana,* frequent; *Rorippa palustris,* v. *hispida,* one station; **Rorippa sylvestris,* rather rare; **Sisymbrium altissimum,* rather rare; **Sisymbrium officinale,* v. *leiocarpum,* common; **Thalaspi arvense,* frequent; **Thalaspi perfoliatum,* two stations.

Capparidaceae: **Cleome houtteana,* one station; *Polanisia dodecandra.* one station.

Resedaceae: **Reseda lutea,* one station.

Droseraceae: *Drosera intermedia,* one station; *Drosera rotundifolia,* rare.

Podostemaceae: *Podostemon ceratophyllum,* probably frequent.

Crassulaceae: **Sedum acre,* one station; **Sedum sarmentosum,* five stations; **Sedum telephium,* fairly frequent; *Sedum ternatum,* rather rare.

Saxifragaceae: *Chrysosplenium americanum,* frequent; *Heuchera americana* (incl. vars.), common; *Hydrangea arborescens,* rare; *Mitella diphylla,* frequent; *Penthorum sedoides,* frequent; **Philadelphus coronarius,* one station; *Ribes americanum,* rather rare; **Ribes grossularia,* one station; *Ribes hirtellum,* rare; *Ribes rotundifolium,* rare; **Ribes rubrum,* two stations; *Saxifraga pensylvanica,* rare; *Saxifraga virginiensis,* common.

Hamamelidaceae: *Hamamelis virginiana* (incl. v. *parvifolia*), common.

Platanaceae: *Platanus occidentalis,* common.

Rosaceae: *Agrimonia gryposepala,* frequent; *Agrimonia microcarpa,* one station; *Agrimonia parviflora,* common; *Agrimonia pubescens,* frequent; *Agrimonia rostellata,* rare; *Agrimonia striata,* rare; *Amelanchier arborea,* frequent; *Amelanchier canadensis,* frequent; *Amelanchier laevis,* fairly frequent; *Amelanchier stolonifera,* rare; *Aronia arbutifolia,* rather rare; *Aronia melanocarpa,* frequent; *Aronia prunifolia,* rare; *Crataegus calpodendron,* one station; *Crataegus crus-galli,* rather rare; *Crataegus holmesiana* (incl. vars.), two stations; *Crataegus intricata,* rather rare; *Crataegus macrosperma* v. *macrosperma,* frequent; *Crataegus macrosperma* v. *roanensis,* one station; *Crataegus monogyna,* one station; *Crataegus pausiaca,* one station; *Crataegus* *pedicillata* v. *pedicillata,* rather rare; *Crataegus pedicillata* v. *ellwangeriane,* one station; *Crataegus pensylvanica,* one station; *Crataegus phaenopyrum,* rather rare; *Crataegus pruinosa* v. *pruinosa,* frequent; *Crataegus pruinosa* v. *latisepala,* six stations; *Crataegus punctata,* rather rare; *Crataegus succulenta,* rare; *Crataegus tatnalliana,* one station; *Crataegus uniflora,* very rare; **Duchesnea indica,* frequent; **Fragaria* × *ananasassa* (*chiloensis* × *virg.*), one station; **Fragaria vesca,* rather rare; *Fragaria virginiana* v. *virginiana,* frequent; *Fragaria virginiana* v. *illinoensis,* one station; **Geum allepicum* v. *strictum,* rare; *Geum canadense* v. *canadensis,* common; *Geum canadense* v. *grimesii,* one station; *Geum laciniatum* v. *laciniatum,* one station; *Geum laciniatum* v. *trichocarpum,* two stations; *Geum rivale,* extirpated; *Geum verum,* rare; *Geum virginianum,* frequent; *Gillenia trifoliata,* frequent; *Malus coronaria,* rather rare; **Malus domestica* (incl. hybrid crab-apples), frequent; *Physocarpus opulifolius,* rather rare; **Potentilla argentea,* two stations; *Potentilla canadensis,* frequent; **Potentilla norvegica* ssp. *monspeliensis,* frequent; **Potentilla recta,* rather rare; **Potentilla reptans,* rare; *Potentilla simplex,* common; *Prunus americana,* frequent; **Prunus avium,* common; **Prunus cerasus,* occasional; **Prunus institia,* one station; *Prunus pensylvanica,* rare; **Prunus persica,* occasional; *Prunus serotina,* common; *Prunus susquehanae,* rare; *Prunus virginiana,* rare; **Rosa canina,* rare; *Rosa carolina,* frequent; **Rosa gallica,* occasional; **Rosa multiflora,* locally abundant; *Rosa palustris,* frequent; **Rosa rubiginosa,* rare; **Rosa rugosa,* two stations; **Rosa setigera,* one station; *Rosa virginiana,* rather rare; *Rubus,* lesser subgenera: *Rubus occidentalis,* common; *Rubus odoratus,* rare; **Rubus phoenicolasus,* frequent; **Rubus strigosus,* rather rare; *Rubus* subgenus *Eubatus: Rubus allegheniensis* (incl. vars.), frequent; *Rubus baileyanaus,* three stations; *Rubus cuneifolius,* rare; *Rubus* subgenus *Eubatus: Rubus enslenii,* nine stations; *Rubus flagellaris,* common; *Rubus frondosus,* common; *Rubus hispidus* (incl. v. *obovalis*), frequent; **Rubus laudatus,* cv. "bundy," one station; *Rubus pensylvanicus,* one station; *Rubus rosa,* one station; *Sanguisorba canadensis,* rather frequent; **Sorbaria sorbifolia,* two stations; *Spiraea alba,* rare; **Spiraea japonica,* locally spreading; *Spiraea latifolia,* frequent; *Spiraea tomentosa,* rare.

LEGUMINOSAE: **Albizia julibrissin,* one station; **Amorpha fruticosa,* locally common; *Amphicarpa bracteata,* common; *Amphicarpa comosa,* rare; *Apios americana,* frequent; *Baptisia tinctoria* (incl. vars.), common; *Cassia fasciculata,* rare; *Cassia hebecarpa,* common; *Cassia nictitans,* common; *Cercis canadensis,* rather rare; **Coronilla varia,* locally abundant; *Crotolaria sagittalis,* rather rare; **Desmanthus illinoensis,* one station; *Desmodium canadense,* rare; *Desmodium canescens,* rare; *Desmodium ciliare,* rare; *Desmodium cuspidatum,* rather rare; *Desmodium glutinosum,* frequent; *Desmodium laevigatum,* rare; *Desmodium marilandicum* frequent; *Desmodium nudiflorum,* common; *Desmodium nuttallii,* rather rare; *Desmodium paniculatum,* common; (*Desmodium pauciflorum,* claimed by Darlington, no known specimen for Chester County or Pennsylvania;) *Desmodium perplexum,* common; *Desmodium rigidum,* rare; *Desmodium rotundifolium,* rare; *Galatia regularis,* extirpated; **Gleditsia triacanthos,* occasional; **Gymnocladus dioica,* occasional; **Lathyrus latifolius,* very local; *Lespedeza capitata* v. *vulgaris,* rare; **Lespedeza cuneata,* one station; *Lespedeza hirta,* common; *Lespedeza intermedia,* frequent; *Lespedeza nuttallii,* rare; *Lespedeza procumbens,* rare; *Lespedeza repens,* frequent; *Lespedeza stipulacea,* one station; **Lespedeza striata,* rare; (*Lespedeza stuvei,* claimed by Darlington, no known specimen;) **Lespedeza thunbergii,* one station; *Lespedeza vio-*

lacea, rare; *Lespedeza virginica*, rather rare; **Lotus corniculatus*, one station; *Lupinus perennis* rather rare; **Medicago lupulina*, common; **Medicago sativa* (incl. albino form), frequent; **Melilotus alba*, common; **Melilotus officinalis*, common (less common than *M. alba*); **Ornithopus perpusillus*, one station; *Phaseolus polystachios* (incl. vars.), rather rare; **Pueraria lobata*, occasional; **Robinia pseudo-acacia*, common; **Robinia viscosa*, occasional; *Strophostyles helvola* (incl. v. *missouriense*), rather rare; *Strophostyles umbellata*, rare; *Stylosanthes biflora*, rather rare; *Stylosanthes riparia*, rare; *Tephrosia virginiana*, rather rare; **Trifolium arvense*, rather rare; **Trifolium aureum*, frequent; **Trifolium campestre*, rather rare; **Trifolium dubium*, one station; **Trifolium hybridum*, common; **Trifolium incarnatum*, occasional; **Trifolium pratense*, common; **Trifolium pratense* f. *leucochraceum*, one station; **Trifolium reflexum*, one station; **Trifolium repens*, v. *repens*, very common; *Vicia americana*, rare; **Vicia angustifolia*, rare; **Vicia cracca*, rather rare; **Vicia dasycarpa*, two stations; **Vicia tetrasperma*, rare; **Vicia villosa*, rare; **Vicia unguiculata*, one station; **Wisteria sinensis*, one station.

GERANIACEAE: **Erodium cicutarium*, rare; *Geranium carolinianum*, rather rare; **Geranium columbianum*, rare; *Geranium maculatum*, common; **Geranium molle*, one station; **Geranium pusillum*, rare; *Geranium robertianum*, one station.

OXALIDACEAE: **Oxalis corniculata*, common; **Oxalis europaea* (incl. vars.), thirteen stations; *Oxalis filipes* (incl. *O. floridana*), *frequent*; *Oxalis stricta*, common; *Oxalis violacea* (incl. v. *trichophora*), frequent.

LINACEAE: *Linum intercursum*, very local (only on serpentine); *Linum medium* v. *texanum*, frequent; *Linum striatum*, rather rare; **Linum usitatissimum*, rather rare; *Linum virginianum* frequent.

RUTACEAE: *Zanthoxylum americanum*, rare.

SIMAROUBACEAE: **Ailanthus altissima*, frequent.

POLYGALACEAE: *Polygala cruciata* v. *aquilonia*, rare; *Polygala curtisii*, one station; *Polygala incarnata*, extirpated; *Polygala nuttallii* rather rare; *Polygala paucifolia*, rare; *Polygala sanguinea* (incl. f. *albiflora*), rather rare; *Polygala senega*, rare; *Polygala verticillata* v. *verticillata*, eight stations; *Polygala verticillata* v. *ambigua*, frequent; *Polygala verticillata* v. *isocycla*, eight stations.

EUPHORBIACEAE: *Acalypha gracilens*, frequent; *Acalypha rhomboidea*, common; *Acalypha virginica*, frequent; **Croton glandulosus* v. *septentrionalis*, two stations; *Euphorbia corollata*, frequent; **Euphorbia cyparissias*, occasional; **Euphorbia dentata*, one station; **Euphorbia esula* (incl. *E. uralensis* Fisch.), one station; **Euphorbia lathyris*, rare; **Euphorbia marginata*, one station; **Euphorbia nutans*, common; **Euphorbia peplus*, one station; *Euphorbia purpurea*, rare; **Euphorbia supina*, thirteen stations; *Phyllanthus caroliniensis*, rare.

CALLITRICHACEAE: *Callitriche austinii*, rather rare; *Callitriche heterophylla*, probably frequent; *Callitriche palustris*, frequent; *Callitriche stagnalis*, two stations.

LIMNANTHACEAE: *Floerkea proserpinacoides*, frequent.

ANACARDIACEAE: *Rhus copallina* v. *latifolia*, frequent; *Rhus glabra*, common; *Rhus typhina*, frequent; *Toxicodendron radicans* v. *radicans*, common; *Taxicodendron vernix*, frequent.

AQUIFOLIACEAE: *Ilex opaca*, rare; *Ilex verticillata*, frequent.

CELASTRACEAE: **Celastrus orbiculatus*, locally abundant; *Celastrus scandens*, frequent; **Euonymus alatus*, occasional; *Euonymus americanus*, rather rare; *Euonymus atropurpureus*, rare; **Euonymus yedoensis*, one station.

STAPHYLEACEAE: *Staphylea trifolia,* frequent.

ACERACEAE: **Acer campestre,* one station; **Acer ginnala,* one station; *Acer negundo,* locally abundant; **Acer palmatum,* one station; **Acer platanoides,* frequent; **Acer pseudo-platanus,* one station; *Acer rubrum* v. *rubrum,* common; *Acer rubrum* v. *trilobum,* frequent; *Acer saccharinum,* common (as an escape); *Acer saccharum,* fairly frequent; *Acer spicatum,* rare.

HIPPOCASTANACEAE: **Aesculus pavia,* one station.

SAPINDACEAE: **Koelreuteria paniculata,* one station.

BALSAMINACEAE: *Impatiens capensis,* common; *Impatiens pallida,* frequent.

RHAMNACEAE: *Ceoanthus americanus,* frequent; **Rhamnus cathartica,* very local.

VITACEAE: *Parthenocissus quinquefolia,* common; *Vitis aestivalis* v. *aestivalis,* frequent; *Vitis aestivalis* v. *argentifolia,* two stations; *Vitis labrusca* (incl. f. *alba*), frequent; *Vitis riparia,* rare; *Vitis vulpina* common.

TILIACEAE: *Tilia americana,* occasional.

MALVACEAE: **Abutilon theophrastii,* common; **Althaea rosea,* one station; **Hibiscus palustris* (incl. *H. moscheutos*), one station; **Hibiscus syriacus,* two stations; **Hibiscus trionum,* frequent; **Malva moschata,* rare escape; **Malva neglecta,* common; **Malva sylvestris,* rare; **Sida spinosa,* frequent.

GUTTIFERAE: *Ascyrum hypericoides* (incl. vars.), rather rare; *Hypericum canadense,* frequent; *Hypericum × dissimulatum* (B × C), rare; *Hypericum gentianoides,* frequent; *Hypericum mutilum,* common; **Hypericum perforatum,* common; *Hypericum punctatum,* frequent; *Hypericum spathulatum,* rare; *Triadenum virginicum* v. *virginicum,* rare; *Triadenum virginicum* v. *fraseri,* one station.

CISTACEAE: *Helianthemum bicknellii,* locally frequent; *Helianthemum canadense,* frequent; *Helianthemum propinquum,* one station; *Lechea intermedia,* rare; *Lechea leggettii,* frequent; *Lechea minor,* frequent; *Lechea racemulosa,* frequent; *Lechea villosa,* rare.

VIOLACEAE: *Hybanthus concolor,* extirpated; *Viola affinis,* frequent; **Viola arvensis,* three stations, "rare escape from cultivation"; *Viola blanda,* frequent; *Viola conspersa,* common; *Viola cucullata,* common; *Viola dilatata,* three stations; *Viola × emarginata,* (*aff.* × *sag.*), rare; *Viola fimbriatula,* common; *Viola hirsutula,* rather rare; *Viola incognita* (incl. forms), five stations; *Viola pallens,* rather rare; *Viola palmata,* frequent; *Viola pedata* v. *pedata,* rare; *Viola pedata* f. *concolor,* common; *Viola pensylvanica,* common; *Viola × porteriana* (*cuc.* × *fimbr.*), two stations; *Viola primulifolia,* common; *Viola pubescens,* common; *Viola rafinesquii,* rare; *Viola rotundifolia,* rare; *Viola sagittata,* frequent; *Viola septentrionalis,* one station; *Viola sororia* v. *sororia* (incl. v. *"papillionacea"*), common; **Viola sororia* cv. *priceana,* one station; *Viola stoneana,* rather rare; *Viola striata,* locally abundant; **Viola tricolor,* one station; *Viola triloba,* common.

THYMELEACEAE: *Dirca palustris,* rare.

ELAEAGNACEAE: **Elaeagnus umbellata,* frequent.

LYTHRACEAE: *Cuphaea petiolata,* common; *Lythrum alatum,* rare; **Lythrum salicaria,* fairly frequent; (*Rotala ramoisior-Ammania humifusa* in Flora Cestrica, claimed by Darlington, no known specimen.)

NYSSACEAE: *Nyssa sylvatica,* frequent.

MELASTOMACEAE: *Rhexia virginica,* rather rare.

ONAGRACEAE: *Circaea lutetiana* v. *canadensis,* common; *Epilobium angustifolium,* rather rare; *Epilobium coloratum,* frequent; *Epilobium leptophyllum,* one station;

Gaura biennis, rather rare; *Ludwigia alternifolia,* frequent; *Ludwigia palustris,* common; *Ludwigia peploides,* Schuylkill River; *Oenothera biennis* (incl. vars.), common; *Oenothera fruiticosa,* locally frequent; *Oenothera laciniata,* rare; *Oenothera perennis,* rather rare; **Oenothera pilosella,* one station; *Oenothera tetragona* v. *tetragona,* five stations; *Oenothera tetragona* v. *latifolia,* one station; *Oenothera tetragona* v. *longistipata,* three stations.

HALORAGACEAE: **Myriophyllum spicatum,* abundant in Schuylkill River.

ARALIACEAE: *Aralia hispida,* rare; *Aralia nudicaulis,* common; *Aralia racemosa,* frequent; **Aralia spinosa,* "ocassional escape"; **Hedera helix,* one station; *Panax quinquefolium,* rare; *Panax trifolium,* common.

UMBELLIFERAE: **Aegopodium podagraria,* frequent; *Angelica atropurpurea,* rare; *Angelica venenosa,* rather rare; **Bupleurum rotundifolium,* one station; *Chaerophyllum procumbens* (incl. v. *shortii*), rare; *Cicuta bulbifera,* rare; *Cicuta maculata,* common; **Conium maculatum,* locally abundant; *Cryptotaenia canadensis,* frequent; **Daucus carota,* very common; **Foeniculum vulgare,* one station; *Heracleum maximum,* common; *Hydrocotyle americana,* common; *Hydrocotyle ranunculoides,* rare; **Hydrocotyle sibthorpioides,* three stations; *Osmorhiza claytonii,* rather rare; *Osmorhiza longistylis* v. *longistylis,* two stations; *Osmorhiza longistylis* v. *villicaulis,* common; *Oxypolis rigidior,* rare; **Pastinaca sativa,* common; **Pimpinella saxifraga,* five stations; *Sanicula canadensis,* common; *Sanicula gregaria,* rather rare; *Sanicula marilandica,* frequent; *Sanicula trifoliata,* rare; *Sium suave,* extirpated; *Taenidia integerrima,* rare; *Thaspium barbinode,* frequent; *Zizia aptera,* common; *Zizia aurea,* rather rare.

CORNACEAE: *Cornus alternifolia,* frequent; *Cornus amomum* v. *amomum,* frequent; *Cornus amomum* v. *schuetziana,* one station; *Cornus florida,* common; *Cornus racemosa,* not common; *Cornus rugosa,* rare.

CLETHRACEAE: *Clethra anifolia,* very rare.

ERICACEAE: *Chimaphila maculata,* common; *Chimaphila umbellata* v. *cisatlantica,* frequent; *Epigaea repens* (incl. v. *glabrifolia*), frequent; *Gaultheria procumbens,* rather rare; *Gaylussacia baccata* (incl. forms), common; *Gaylussacia dumosa* (incl. v. *bigeloviana*), extirpated; *Gaylussacia frondosa,* rather rare; *Kalmia angustifolia* (incl. f. *candida*), rather rare; *Kalmia latifolia* (incl. forms), common; *Leucothoe racemosa,* extirpated; *Lyonia ligustrina,* frequent; *Lyonia mariana,* rather rare; *Monotropa hypopithys* v. *hypopithys,* frequent; *Monotropa hypopithys* v. *rubra,* three stations; *Monotropa uniflora,* common; *Pyrola elliptica,* frequent; *Pyrola rotundifolia* v. *americana,* frequent; *Pyrola secunda,* very rare; *Pyrola virens* v. *convoluta,* very rare; *Rhododendron maximum,* very rare; *Rhododendron periclymenoides* v. *periclymenoides,* nine stations; *Rhododendron periclymenoides* v. *eglandulosum,* common; *Rhododendron viscosum* v. *viscosum,* rather rare; *Rhododendron viscosum* v. *glaucum,* rare; *Vaccinium angustifolium,* rare; *Vaccinium atrococcum,* locally frequent; *Vaccinium brittonii,* four stations; *Vaccinium caesariense,* four stations; *Vaccinium corymbosum* v. *corymbosum* frequent; *Vaccinium corymbosum* v. *glabrum,* three stations; *Vaccinium lamarckii,* one station; *Vaccinium macrocarpon,* very rare; *Vaccinium stamineum* v. *stamineum,* frequent; *Vaccinium stamineum* v. *interius,* two stations; *Vaccinium stamineum* v. *neglectum,* six stations; *Vaccinium vacillans,* common.

PRIMULACEAE: **Anagallis arvensis,* rather rare; *Lysimachia ciliata,* frequent; *Lysimachia lanceolata,* extirpated; **Lysimachia nummularia,* common; *Lysimachia quadrifolia,* common; *Lysimachia terrestris,* rather rare; *Samolus parviflorus,* extirpated; *Trientalis borealis,* rare.

EBENACEAE: *Diospyros virginiana*, rather rare.

OLEACEAE: *Chionanthus virginicus*, rare; *Fraxinus americana* v. *americana*, common; *Fraxinus americana* v. *biltmoreana*, two stations; *Fraxinus iodocarpa*, one station; *Fraxinus nigra*, rather rare; *Fraxinus pensylvanica* v. *pensylvanica*, frequent; *Fraxinus pensylvanica* v. *subintegerrima*, probably frequent; **Ligustrum obtusum*, two stations; *Ligustrum vulgare*, frequent.

GENTIANACEAE: *Bartonia paniculata*, rare; *Bartonia virginica*, frequent; **Centaurium pulchellum* rare; *Gentiana andrewsii*, rather rare; *Gentiana clausa*, rare; *Gentiana crinita*, rare; *Gentiana saponaria*, rare; *Gentiana villosa*, rare; **Nymphoides peltata*, one station; *Obolaria virginica*, frequent; *Sabatia angularis*, frequent; *Sabatia angularis* f. *albiflora*, one station.

APOCYNACEAE: **Amsonia tabernaemontana*, two stations; *Apocynum androsaemifolium*, frequent; *Apocynum cannabinum* v. *cannabinum*, frequent; *Apocynum cannabinum* v. *glaberrimum*, five stations; *Apocynum cannabinum* v. *pubescens*, four stations; *Apocynum* × *medium* (*andros.* × *cann.*), frequent; *Apocynum sibiricum*, rare; **Vinca minor*, occasional.

ASCLEPIADACEAE: *Asclepias amplexicaule*, rare; *Asclepias exaltata*, rather rare; *Asclepias incarnata* v. *incarnata*, frequent; *Asclepias incarnata* v. *pulchra*, common; *Asclepias purpurascens*, frequent; *Asclepias quadrifolia*, frequent; *Asclepias rubra*, extirpated; *Asclepias syriaca* (incl. forms), common; *Asclepias tuberosa*, frequent; *Asclepias variegata*, rare; *Asclepias verticillata*, locally common; *Asclepias viridiflora*, rare; **Cynanchum nigrum*, one station; *Matalea obliqua*, rare.

CONVOLVULACEAE: **Calystegia hederacea*, one station; **Calystegia pubescens*, one station; **Calystegia sepium* ssp. *americana*, frequent; **Calystegia sepium americana* pubescent f., one station; *Calystegia spithamaea*, rare; **Convolvulus arvensis*, locally frequent; *Cuscuta campestris*, one station; *Cuscuta cephalanthii*, rare; (**Cuscuta epilinum*, "formerly a great pest among the Flax crops . . . it has since become quite rare," Flora Cestrica ed. III, no known specimen;) *Cuscuta gronovii* v. *gronovii*, common; *Cuscuta gronovii* v. *latiflora*, one station; **Ipomoea hederacea*, rather rare; *Ipomoea pandurata*, frequent; **Ipomoea purpurea*, frequent.

POLEMONIACEAE: *Phlox divaricata* ssp. *divaricata*, very rare; **Phlox divaricata* ssp. *laphamii*, one station; *Phlox maculata* ssp. *maculata*, frequent; *Phlox maculata* ssp. *pyramidalis*, rare; **Phlox paniculata*, three stations; *Phlox pilosa* (purple), rare; (*Phlox stolonifera*, "Woodlands, near Paoli: very rare," the *P. reptans* of Flora Cestrica ed. III, no known specimen, old record in Delaware Co. near Chester Co. line may be Darlington's locale;) *Phlox subulata* (incl. forms), locally very common (only on serpentine as of 1984); *Polemonium reptans*, frequent; *Polemonium reptans* (pubescent f.), two stations.

HYDROPHYLLACEAE: *Ellisia nyctelea*, rare; *Hydrophyllum virginianum*, locally abundant; (*Phacelia purshii* supposedly collected in 1899 by Stone as a waif, specimen cannot be located.)

BORAGINACEAE: **Asperugo procumbens*, one station; **Cynoglossum officinale*, rare; *Cynoglossum virginianum*, frequent; **Echium vulgare* (incl. forms), rather rare; *Hackelia virginiana*, frequent; **Lithospermum arvense*, frequent; *Lithospermum canescens*, extirpated; *Mertensia virginica*, locally frequent; *Myosotis laxa*, frequent; **Myosotis scorpioides*, rare; *Myosotis verna*, rare; (*Onosmodium virginianum*, "Great Valley, not common," Flora Cestrica ed. III, no known specimen;) **Symphytum officinale*, rare.

VERBENACEAE: *Lippia lanceolata* v. *recognita*, extirpated; *Verbena* × *engelmannii* (*hastata* × *urtic.*), one station; *Verbena hastata,* frequent; *Verbena simplex,* rare; *Verbena urticifolia* v. *urticifolia,* common; *Verbena urticifolia* v. *leiocarpa,* eight stations; **Vitex agnus-castus,* one station.

LABIATAE: *Agastache nepetoides,* rather rare; *Agastache scrophulariaefolia* v. *scrophulariaefolia,* rare; *Agastache scrophulariaefolia* v. *mollis,* one station; **Ajuga reptans,* one station; **Blephilia ciliata,* rare; **Blephilia hirsuta,* rare; *Collinsonia canadensis,* frequent; *Cunila origanoides,* frequent; **Galeobdolon luteum,* one station; **Glechoma hederacea* (incl. v. *micrantha*), common; *Hedeoma pulegioides,* frequent; **Lamium amplexicaule,* frequent; **Lamium purpureum,* common; **Leonurus cardiata,* frequent; **Leonurus marrubiastrum,* rather rare; *Lycopus americanus,* frequent; *Lycopus* × *sherardii* (*un.* × *virg.*), one station; *Lycopus uniflorus,* frequent; *Lycopus virginicus,* common; **Marrubium vulgare,* one station; **Melissa officinalis,* two stations; **Mentha alopecuroides,* rare; *Mentha arvensis* v. *arvensis,* rather rare; *Mentha arvensis* v. *villosa,* frequent; **Mentha gentilis* one station; **Mentha longifolia,* rare; **Mentha piperata,* common; **Mentha spicata,* common; *Monarda clinopodia,* seven stations; **Monarda didyma,* occasional; *Monarda fistulosa* v. *fistulosa,* four stations; *Monarda fistulosa* v. *mollis,* frequent; *Monarda fistulosa* (white f.), one station; **Nepeta cataria,* frequent; **Ocimum basilicum,* one station; **Perilla frutescens,* locally very abundant; *Physostegia virginiana* v. *granulosa,* extirpated; **Prunella vulgaris* v. *lanceolata,* common; *Pycnanthemum clinopodioides,* rare; *Pycnanthemum incanum,* frequent; *Pycnanthemum muticum,* rather rare; *Pycnanthemum pilosum,* rare; *Pycnanthemum tenuifolium,* common; *Pycnanthemum verticillatum,* three stations; *Pycnanthemum virginianum,* common; *Salvia lyrata,* frequent; **Salvia sylvestris,* two stations; **Satureja vulgaris* v. *neogaea,* frequent; *Scutellaria elliptica,* frequent; *Scutellaria epilobiifolia,* rare; *Scutellaria integrifolia,* frequent; *Scutellaria lateriflora,* frequent; *Scutellaria nervosa,* rare; *Scutellaria parvula* v. *leonardii,* rare (mostly on serpentine); **Stachys germanica,* one station; **Stachys palustris,* rare; *Stachys tenuifolia* v. *tenuifolia,* rather rare; *Stachys tenuifolia* v. *hispida,* one station; *Stachys tenuifolia* v. *platyphylla,* six stations; **Teucrium canadense* v. *virginicum,* frequent; **Thymus serpyllum,* one station; *Trichostema brachiatum,* one station; *Trichostema dichotomum,* frequent.

SOLANACEAE: **Datura stramonium* (incl. f. *inermis*), frequent; **Lycium halimifolium,* "sparingly escaped," occasional; **Lycopersicon esculentum,* one station; **Nicotiana tabacum,* one station; *Physalis heterophylla* v. *heterophylla,* frequent; *Physalis heterophylla* v. *ambigua,* two stations; *Physalis subglabra,* frequent; **Solanum carolinense,* (incl. f. *albiflorum*), common; **Solanum dulcamara* v. *dulcamara,* occasional; **Solanum nigrum,* common; **Solanum rostratum,* one station.

SCROPHULARIACEAE: (*Agalinis paupercula,* claimed by Stone, no known specimen;) *Agalinis purpurea,* rare; *Agalinis tenuifolia,* frequent; *Aureolaria flava,* frequent; *Aureolaria pedicularia* (incl. v. *intercedens*), frequent; *Aureolaria virginica,* frequent; *Buchnera americana,* one station; *Castilleja coccinea,* rare; **Chaenorrhinum minus,* rare; *Chelone glabra* v. *glabra* (incl. f. *tomentosa*), frequent; **Cymbalaria muralis,* rare; *Gratiola neglecta,* frequent; *Linaria canadensis,* one station; **Linaria vulgaris,* common; *Lindernia anagallidea,* rare; *Lindernia dubia,* frequent; **Mazus reptans,* one station; *Melampyrum lineare* v. *americanum,* common; *Mimulus alatus* (incl. f. *albiflorus*), rare; *Mimulus ringens* (incl. f. *peckii*), frequent; *Pedicularis canadensis* (incl. color forms), frequent; *Pedicularis lanceolata,* rather rare; **Penstemon calycosus,* rare; **Penstemon digitalis,* frequent; *Penstemon hirsutus,* rare; **Pen-*

stemon laevigatus, rare; **Penstemon pallidus*, one station; *Scrophularia lanceolata*, frequent; *Scrophularia marilandica*, frequent; **Tomanthera auriculata*, one station; **Verbascum blattaria*, common; **Verbascum lychnitis*, one station; **Verbascum thapsus*, common; *Veronica americana*, frequent; **Veronica anagallis-aquatica*, rare; **Veronica arvensis*, common; **Veronica comosa*, two stations; **Veronica filiformis*, six stations; **Veronica hederaefolia*, rare; **Veronica officinalis*, common; **Veronica peregrina*, common;**Veronica persica*, rare; *Veronica scutellata*, extirpated; **Veronica serpyllifolia*, common; *Veronicastrum virginicum*, frequent.

BIGNONIACEAE: **Campsis radicans*, one station; **Catalpa bignonioides*, occasional near houses & villages; **Paulownia tomentosa*, fairly frequent.

OROBANCHACEAE: *Conopholis americana*, rare; *Epifagus virginiana*, common; *Orobanche uniflora*, rather rare.

LENTIBULARIACEAE: *Utricularia vulgaris*, extirpated.

ACANTHACEAE: *Justicia americana*, rare.

PHRYMACEAE: *Phryma leptostachya*, frequent.

PLANTAGINACEAE: **Plantago aristata*, rare; **Plantago lanceolata*, common; **Plantago major*, rather rare; **Plantago rugelii*, very common; *Plantago virginica*, frequent.

RUBIACEAE: *Cephalanthus occidentalis*, frequent; *Diodia teres*, rather rare; **Galium aparine*, common; *Galium asprellum*, common; *Galium boreale* (incl. vars.), rare; *Galium circaezans* v. *circaezans*, frequent; *Galium circeazans* v. *hypomalacum*, eight stations; *Galium concinnum*, rare; *Galium lenceolatum*, frequent; **Galium mollugo*, rare; *Galium obtusum*, frequent; *Galium pilosum*, frequent; *Galium tinctorium*, frequent; *Galium triflorum* (incl. v. *asprelliforme*), frequent; **Galium verum*, rare; *Hedyotis caerulea*, common; *Hedyotis purpurea* v. *longifolia*, extirpated; *Mitchella repens*, common.

CARPRIFOLIACEAE: *Diervilla lonicera*, rather rare; **Lonicera* × *bella* (*morr.* × *tat.*), one station; *Lonicera candensis*, extirpated; *Lonicera dioica*, rare; **Lonicera japonica* v. *japonica*, common; **Lonicera japonica* v. *chinensis*, one station; **Lonicera morrowii*, frequent; *Lonicera sempervirens*, rather rare; **Lonicera xylosteum*, one station; *Sambucus canadensis*, common; *Sambucus pubens*, rare; **Symphoricarpos albus* v. *laevigatus*, one station; **Symphoricarpos orbiculatus*, rather rare; *Triosteum angustifolum*, extirpated; *Triosteum aurantiacum* v. *aurantiacum*, frequent; *Triosteum aurantiacum* v. *glaucescens*, one station; *Triosteum perfoliatum*, rare; *Viburnum acerifolium*, common; *Viburnum cassinoides*, rare; *Viburnum dentatum* (incl. v. *deamii*), frequent; *Viburnum lentago*, rare; *Viburnum nudum*, rare; **Viburnum opulus*, one station; **Viburnum plicatum* v. *tomentosum*, one station; *Viburnum prunifolium*, common; *Viburnum rafinesquianum*, rare; *Viburnum recognitum*, eleven stations.

VALERIANACEAE: *Valerianella intermedia*, one station; *Valerianella olitoria*, rare; *Valerianella patellaria*, rare.

DIPSACACEAE: **Dipsacus sylvestris*, locally frequent.

CUCURBITACEAE: **Echinocystis lobata*, occasional; *Sicyos angulatus*, frequent, mostly introduced.

CAMPANULACEAE: *Campanula americana*, rare; *Campanula aparinoides*, frequent; **Campanula rapunculoides*, occasional; *Campanula rotundifolia*, rare; *Triodanis perfoliata*, common.

LOBELIACEAE: *Lobelia cardinalis*, frequent; *Lobelia inflata*, common; *Lobelia pu-*

berula, rare; *Lobelia siphilitica,* common; *Lobelia spicata* v. *spicata,* frequent; *Lobelia spicata* v. *campanulata,* four stations; *Lobelia spicata,* v. *scaposa,* one station.

COMPOSITAE: **Achillea millefolium* (incl. *A. lanulosa),* common; **Ambrosia artemisifolia* v. *elatior,* common; *Ambrosia trifida,* common; *Ambrosia trifida* f. *integrifolia,* two stations; *Anaphalis margaritacea,* rather rare; *Antennaria fallax,* frequent; *Antennaria neglecta,* common; *Antennaria neodioica* v. *neodioica,* common; *Antennaria neodioica* v. *attenuata,* one station; *Antennaria parlinii,* rare; *Antennaria plantaginifolia,* common; **Anthemis arvensis,* rather rare; **Anthemis cotula,* frequent; **Anthemis tinctoria,* rare; **Arctium lappa,* rare; **Arctium minus,* very common; **Arctium nemorosum,* two stations; *Arnica acaulis,* rare; **Artemisia annua,* two stations; **Artemisia ludoviciana* (incl. vars.), one station; *Aster acuminatus,* rare; *Aster cordifolius,* common; *Aster depauperatus,* locally abundant (only on serpentine); *Aster divaricatus,* common; *Aster dumosus* (incl. v. *cordifolius*), rare; *Aster infirmis,* frequent; *Aster laevis,* frequent; *Aster lateriflorus,* common; *Aster linariifolius,* rather rare; *Aster lowrieanus,* three stations; *Aster macrophyllus* (incl. vars.), frequent; *Aster novae-angliae,* frequent; *Aster novae-angliae* f. *roseus,* one station; *Aster patens* v. *patens,* frequent; *Aster patens* v. philogifolius, rather rare; *Aster pilosus* v. *pilosus,* seven stations; *Aster pilosus* v. *platyphyllus,* rare; *Aster pilosus* v. *demotus,* common; *Aster prenanthoides,* frequent; *Aster puniceus* common; *Aster radula,* rare; *Aster sagittifolius,* rather rare; *Aster schreberi,* frequent; *Aster simplex,* common; *Aster umbellatus* v. *umbellatus,* frequent; *Aster undulatus* v. *undulatus,* common; **Baccharis halimifolia,* two stations; *Bidens bipinnata,* common; *Bidens cernua,* common; *Bidens comosa,* frequent; *Bidens connata* v. *petiolata,* frequent; *Bidens frondosa,* common; **Bidens polylepis,* occasional; *Bidens vulgata,* rather rare; *Cacalia atriplicifolia,* frequent; **Carduus crispus,* rare; **Carduus nutans,* fairly frequent, locally abundant; **Centaurea jacea,* rare; **Centaurea maculosa,* four stations; **Centaurea nigra* (incl. v. *radiata,* two stations; **Centaurea solstitalis,* one station; **Centaurea vochinensis,* rare; *Chrysanthemum leucanthemum* v. *pinnatifidum,* common; **Chrysanthemum parthenium,* occasional escape; **Cichorium intybus,* frequent; **Cichorium intybus* f. *album,* one station; *Cirsium altissimum,* rare; **Cirsium arvenense* v. *arvense,* common; **Cirsium arvense* v. *albiflorum,* one station; **Cirsium arvense* v. *integrifolium,* five stations; **Cirsium arvense* v. *vestitum,* six stations; *Cirsium discolor,* common; *Cirsium horridulum,* rare; *Cirsium muticum,* frequent; *Cirsium pumilum,* frequent; **Cirsium vulgare,* common; **Coreopsis lanceolata* (incl. *C. grandiflora*), rare; **Coreopsis tinctoria,* one station; **Crepis capillaris,* one station; **Crepis setosa,* one station; **Eclipta alba,* rare; *Elephantopus carolinianus,* rare; *Erechtites hieracifolia* (incl. vars.), common; *Erigeron annus,* common; *Erigeron canadensis,* common; *Erigeron philadelphicus,* common; *Erigeron pulchellus,* frequent; *Erigeron strigosus,* common; *Eupatorium aromaticum,* frequent; *Eupatorium coelestinum,* very rare; *Eupatorium dubium,* frequent; *Eupatorium fistulosum,* common; *Eupatorium hyssopifolium* (incl. vars.), one station; *Eupatorium perfoliatum,* common; *Eupatorium perfoliatum* f. *purpureum,* two stations; *Eupatorium pilosum,* frequent; *Eupatorium pubescens,* rare; *Eupatorium purpureum,* common; *Eupatorium rotundifolium,* rare; *Eupatorium rugosum,* common; *Eupatorium sessilifolium,* frequent; **Filago germanica,* one station; **Galinsoga ciliata,* very common; *Gnaphalium obtusifolium,* common; *Gnaphalium purpureum,* rather rare; *Gnaphalium uliginosum,* rare; *Helenium autumnale,* frequent; *Helenium flexuosum,* locally abundant; **Helianthus annus,* two stations; *Helianthus decapetalus,* frequent; *Helianthus divaricatus,* frequent; *Helianthus giganteus,* common; **Helianthus grosseserratus,* two stations; *Helianthus laetiflorus* (incl. vars.), one station; *Helianthus strumosus,* rather rare; **Helianthus tuberosus,* rare escape; *Heliopsis helianthoides,* rare; *Heterotheca mariana,* rare; **Hieracium flagellare,* rare; **Hieracium florentinum,* one station; *Hieracium gronovii,* rather rare; (*Hieracium marianum,* claimed by Stone, no known specimen;) *Hieracium paniculatum,* frequent; **Hieracium pratense,* frequent; *Hieracium scabrum,* rather rare; *Hieracium venosum* (incl. vars.), frequent; **Hypochaeris radicata,* one station; **Inula helenium,* rare escape; **Ixeris stolonifera,* two stations; *Krigia biflora,* frequent; *Krigia virginica,* rather rare; *"Kuhnia": Brickellia eupatorioides,* extirpated; *Lactuca biennis,* common; *Lactuca canadensis* v. *canadensis,* rather rare; *Lactuca canadensis* v. *latifolia,* common; *Lactuca canadensis* v. *longifolia,* nine stations; *Lactuca floridana* v. *floridana,* rather rare; *Lactuca floridana* v. *villosa,* rather rare; **Lactuca saligna,* one station; **Lactuca sativa,* one station; **Lactuca scariola* v. *scariola,* common; **Lactuca scariola* v. *integrata,* three stations; **Lapsana communis,* rare; **Liatris pycnostachya,* very local; *Liatris scariosa,* extirpated; *Liatris spicata,* rather rare; **Matricaria matricarioides,* three stations; *Mikania scandens,* rather rare; **Parthenium hysterophorus,* one station; **Picris hieracioides,* one station; (*Polymnia candensis,* "formerly . . . along the Brandywine, is now extremely rare," Flora Cestrica ed. III, no known specimen;) *Polymnia uvedalia,* extirpated; *Prenanthes alba,* rather rare; *Prenanthes altissima* frequent; *Prenanthes serpentaria,* frequent; *Prenanthes trifoliata,* frequent; *Rudbeckia fulgida,* rare; **Rudbeckia hirta* v. *pulcherrima,* common; *Rudbeckia laciniata* v. *laciniata,* common; *Rudbeckia triloba,* one station; *Senecio aureus* v. *gracilis,* common; *Senecio aureus* v. *intercursus,* eight stations; *Senecio obovatus,* rare; *Senecio pauperculus,* rather rare; *Senecio smallii,* locally abundant; **Senecio vulgaris,* rare; *Sericocarpus asteroides,* frequent; *Sericocarpus linifolius,* rare; **Silphium perfoliatum,* rare; *Solidago altissima,* frequent; *Solidago arguta,* rather rare; *Solidago bicolor,* common; *Solidago caesia,* common; *Solidago canadensis* v. *hargeri,* common; *Solidago flexicaulis,* frequent; *Solidago gigantea* v. *gigantea,* frequent; *Solidago gigantea* v. *leurophylla,* three stations; *Solidago graminifolia* v. *nuttallii,* common; *Solidago juncea,* frequent; *Solidago nemoralis,* common; *Solidago odora,* rather rare; *Solidago patula,* frequent; *Solidago puberula,* rather rare; *Solidago rugosa* v. *rugosa,* common; *Solidago rugosa* v. *aspera,* six stations; *Solidago rugosa* v. *villosa,* three stations; *Solidago sempervirens,* rare; *Solidago speciosa,* extirpated; *Solidago squarrosa,* rather rare; *Solidago uliginosa,* rare; *Solidago ulmifolia,* rather rare; **Sonchus asper,* rare; **Sonchus oleraceus,* frequent; **Sonchus uliginosus,* rare; **Tanacetum vulgare,* frequent; **Taraxacum erythrospermum,* occasional; **Taraxacum officinale,* very common; **Tragopogon major,* one station; **Tragopogon porrifolius,* two stations; **Tragopogon pratensis,* three stations; **Tussilago farfara,* occasional; (*Verbesina alternifolia,* = *Actinomeris squarrosa* in Flora Cestrica, no known specimen;) *Vernonia glauca,* rather rare; *Vernonia noveboracensis,* common; **Xanthium chinense,* two stations; **Xanthium italicum,* seven stations.

Bartonia No. 52: 78, 1986

Additions to the Check-List of the Flora of Montgomery County, IV

ANN NEWBOLD
R.D. 1 Bechtelsville, PA 19505

ROBERT J. HOLT
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Five new species of Montgomery County flora (see Edgar T. Wherry's *Check-List* in Bartonia 41: 71–84, Ann Newbold's *Additions* in 45: 5 and 46: 49 and McCabe and Newbold in 47: 36) bring the current total of recorded taxa with herbarium specimens to 1845 of which 1238 are presumed to be indigenous and 607 introduced. *Wolffia brasiliensis* is also new to the records of the flora of the state.

Wolffia brasiliensis Weddell was located in a pond within the Borough of Pottstown. It appears generally to be a southern species at its northern limits.

Epipactis helleborine (L.) Crantz, an alien now prevalent in the Pocono region, was discovered in the rich woods of Valley Forge Park.

Plantanthera orbiculata (Pursh) Lindl., a native, has been found in Lower Merion Township. A validating photograph, but no specimen, was taken.

Anthriscus sylvestris (L.) Hoffm., a coarse plant of fields and waste places, naturalized from Europe, is now making its way southward from Canada. Some robust plants were found along the Perkiomen Creek in the Central Perkiomen Valley Park in Skippack Township. Since the *Atlas* shows only two locations in the state, it should also be mentioned that a large stand was found this past summer at the Rest Stop along Route 611 at the Delaware Water Gap in Northampton County.

Solidago odora Ait. was found in a dry, sandy habitat on Mount Joy in Valley Forge Park. Other specimens were discovered in the herbarium for the county, but the species had been overlooked in the original check-list of the county flora.

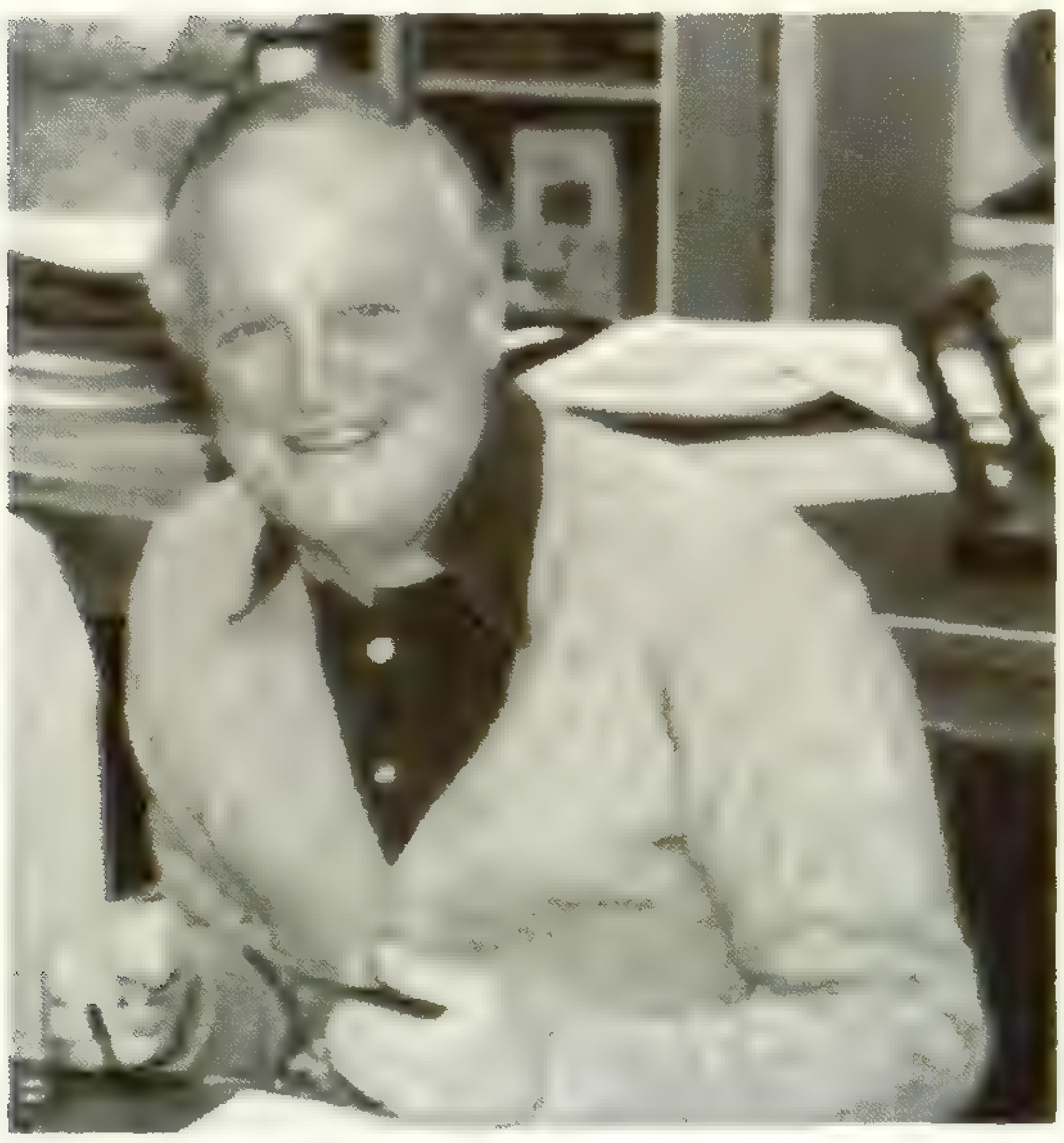
Bartonia No. 52: 79–81, 1986

OBITUARIES

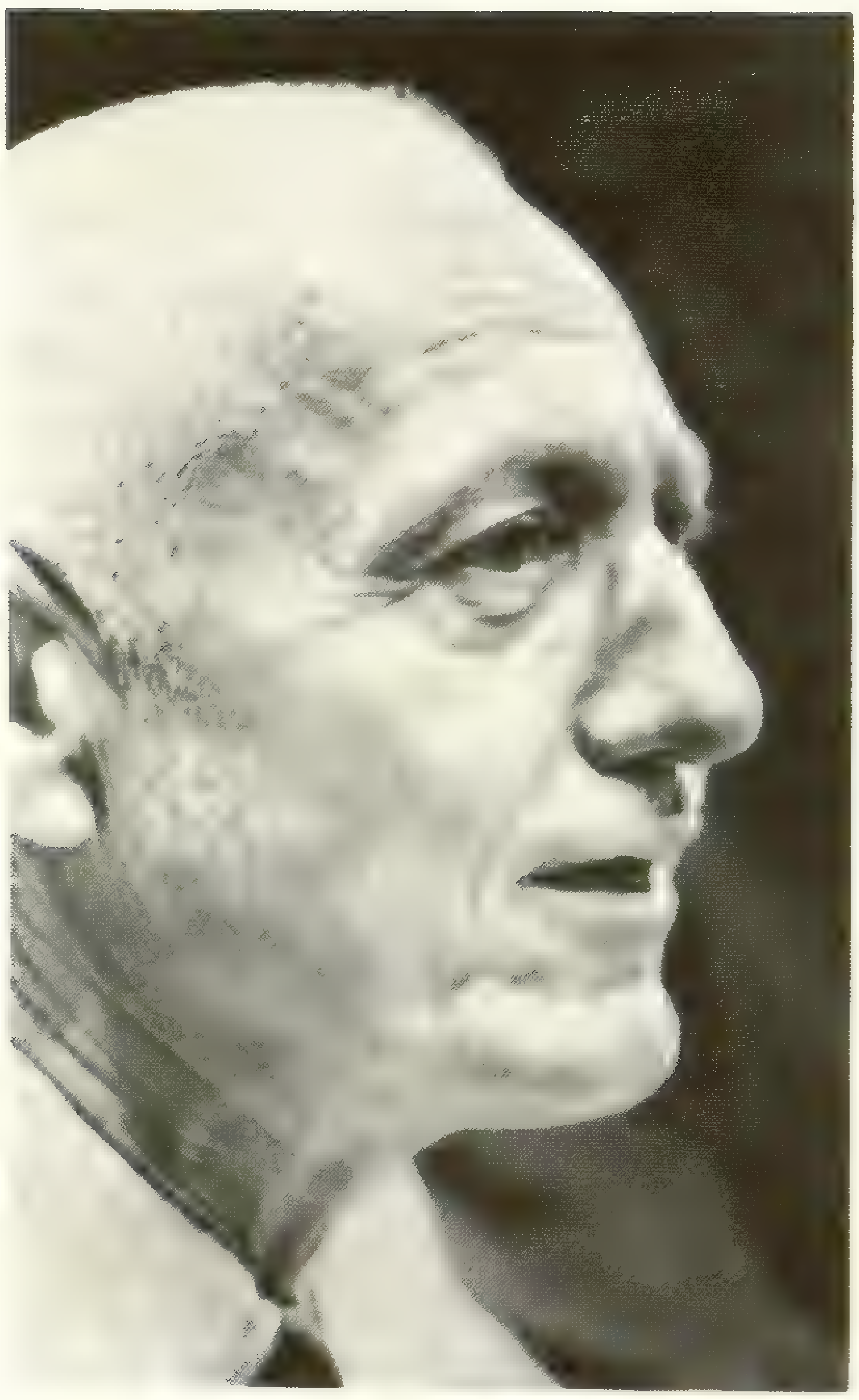
Nellie Alexander Erisman (13 April 1899–10 February 1985). Nellie Erisman was an honorary member of the Philadelphia Botanical Club and former assistant in the herbaria of the Academy of Natural Sciences and the University of Pennsylvania. She had been a member of the Botanical Club since 1945.

She was born in Roxbury, Pennsylvania, and grew up in Franklin County, Pennsylvania. She married Charles Erisman in Lancaster on 2 September 1919 and resided in Philadelphia since 1920. She started working in the herbarium of the University of Pennsylvania in 1938 and soon afterward was also working in the Academy's herbarium. Her conscientious attitude and careful work were appreciated by many botanists who recognized her as a person with exceptional skills. While fulfilling her day to day work obligations, she became a knowledgeable botanist and contributed numerous specimens to the Academy and University. She worked closely with Mr. Long in the Academy's local herbarium and also did much to aid Drs. Wherry, Fogg, and Wahl with their *Atlas of the Flora of Pennsylvania*. After she retired in 1978, Nellie did volunteer work for the Academy at her apartment in Spring Garden Towers where she continued to mount specimens and type labels.

Nellie is survived by two sons (Charles and James), one daughter (Mary E. Garback, an assistant in the Academy's Botany Department), seven grandchildren (including M. Andria Garback who works in the Academy's Malacology Department), and five great-grandchildren. ALFRED E. SCHUYLER



E. Harrison Rigg (10 September 1912–8 June 1985. Harrison Rigg, former treasurer of the Philadelphia Botanical Club, was a retired manager in the Pennsylvania Railroad's department of data processing. He was born in Philadelphia, attended Radnor High School, and graduated from Harvard College in 1934 with a bachelor's degree in mathematics. He was an Eagle Scout and was interested in Natural History. A graduate of the Barnes Arboretum, Harrison did volunteer work for many years at the Academy of Natural Sciences where he worked closely with Grace Tees in the local herbarium. He also was a ham radio operator, was active in the Audubon Society, and belonged to Trinity Episcopal Church in Gulph Mills. He resided in King of Prussia and is survived by his wife Shethra, three sons (Gary, David, and John), a daughter (Sarah E. Funkhouser), a brother, a sister, and nine grandchildren. ALFRED E. SCHUYLER



Ralph Millard Sargent (12 May 1904–17 June 1985). Ralph Sargent died last spring in Bryn Mawr, Pennsylvania, aged 81 after a brief illness. An enthusiastic supporter and former president of the Philadelphia Botanical Club, he was an accomplished amateur botanist, a gifted botanical photographer, and an inspired lecturer on our flora, particularly of the unique 4200 ft montane environment he visited every summer for more than forty years at Highlands, North Carolina. In his 70's he spent several summers jeeping along the route of William Bartram's famous botanizing trip through North and South Carolina, Georgia, and Florida, and in 1977 he published *Biology in the Blue Ridge* (Highlands, The Highlands Biological Foundation, Inc.) in which he described his first visit to the region in 1931:

> When on my climb up Satulah in June that year I came upon my first sight of Flame Azaleas in bloom. I knew I had seen the most colorful mountain shrubs in America. My love affair with the Appalachian flora began at that moment. . . .

Ralph was also a distinguished Renaissance scholar and Shakespeare editor, and was admired for his definitive biography of the poet Edward Dyer, *At the Court of Queen Elizabeth.* Other published works were *Books of the Renaissance,* and his lively Pelican Shakespeare edition of *As You Like It.* In his introduction to the latter he had his botanizing pleasures in mind when he wrote, "The natural woodland provides a morally restorative and regenerative stimulus. . . ." He went on to consider the role of pastoral literature and the escape fantasies of city people, but there was nothing of "escape"—fantasy or otherwise—in Ralph's life; he was as energetic in the wild as he was in the classroom and the library.

Ralph was born in Austin, Minnesota, and raised in Red Wing, Minnesota. He graduated from Carleton College in 1925, and after teaching high school for a year to raise money, went to Yale where he received his Ph.D. in English literature in 1931, concentrating in Renaissance studies. He hit on Dyer as a thesis topic only after he discovered that someone else had just published the book on Sir Walter Raleigh that Ralph had planned to write. What attracted him to Dyer and Raleigh was what he had in common with those two Cavaliers, a lively Elizabethan gusto and an unlimited hunger for life.

He taught at Carleton and Knox Colleges before Felix Morley (his brother in humor) recruited him to come to Haverford in 1941. He was named Gummere Professor of Literature in 1947 (the most distinguished chair in the College) and served as Chairman of the English Department from 1949–1962. He retired in 1970, admired and loved by more than thirty classes of Haverford students for his Renaissance personality, his style (not least the sartorial), and the probing quality of his character. His manner of teaching was elegant and sensitive, vigorous, energetic, encouraging and endlessly humorous with a good strong Rabelaisian vein. He was tall (his height accentuated by his leanness), very fair, kept his hair cut in a burr, had clear flax flower blue eyes and surprisingly large hands. He rocked in cadence when he spoke, and he spoke and read aloud splendidly, in a deep, unhesitating voice. He listened with a disconcerting attentiveness, challenging, nodding, and laughing appreciatively to spur the speaker on. His snorts of approbation warmed many a lecturer's heart.

He was a fine speaker in Haverford Meeting, sometimes reading aloud from the Bible and telling simply what the passage meant to him. One Sunday he quoted this from Sir Thomas Browne's 1635 *Religio Medici:*

> There are two bookes from whence I collect my Divinity; besides that written one of God, another of his servant Nature, that universall and publik Manuscript, that lies expans'd unto the eyes of all; those that never saw him in the one, have discovered him in the other. . . .

He was interested in natural history and produced an outstanding edition of Peter Kalm's *Travels into North America* (Barre: The Imprint Society, 1972). One comment from his introduction reveals an important aspect of Ralph's broad interests:

> In both detail and comprehensiveness, Kalm's *Travels* becomes the first, and a model, American ecology, centered on man as a factor in his changing environment. Anyone who proposes to study American ecology cannot ignore it. Not only does Kalm clearly indicate, with continuing prophetic insight, the dangers of human exploitation on the environment, but he points the way to means by which Americans and their wealth of natural resources can flourish in a happier symbiosis.

In addition to numerous literary and academic associations, Ralph was a member of the Pennsylvania Horticultural Society, Explorer's Club, honorary member Philadelphia Botanical Club, and a director of the Henry Foundation. He was past president of the Highlands Biological Station. ALAN W. ARMSTRONG.

REVIEW

The Physiological Ecology of Seaweeds, by Christopher S. Lobban, Paul J. Harrison, and Mary Jo Duncan. Cambridge University Press, Cambridge. 1985. ix + 242 pp. $44.50.

Lobban, Harrison and Duncan have published a volume that is quite different from the traditional phycology text: lacking are the usual chapters on algal structure, reproduction, systematics and distribution. Instead they present ". . . a discussion of the physiology and ecology of seaweeds . . . intended as a sequel to a course in seaweed structure and reproduction." This book is written for the advanced undergraduate/postgraduate student and stems from Lobban's lecture materials at the University of New Brunswick. The volume is clearly written and well produced—very few typographical errors are present.

Physiological Ecology of Seaweeds for the most part delivers as promised. It is similar in content to earlier volumes on phytoplankton ecology and physiology, such as the excellent works of Raymont (1980) and Morris (1980), and is more focused than Round's (1981) recent algal ecology text. The authors focus on macroalgae, omitting studies of phytoplankton and microbenthos unless absolutely necessary. I find this decision personally unfortunate because it reduces the book's general usefulness, but it does keep the length of each chapter bearable. As it stands, it is well suited for a one semester course in seaweed ecology. It will serve as an excellent companion to traditional phycology texts and will have a central spot on my reference shelf, as well.

The selection and organization of main topics are sensible. Physical and biochemical factors affecting growth and physiology comprise the first 85% of the book. These are followed by a discussion of seaweed development and life histories and a rather weak chapter on mariculture. The large majority of the chapters are well written; however, their quality and accuracy vary. I found some chapters too detailed (for example, Light and photosynthesis); others (Pollution, Mariculture) were not as carefully prepared and contained some inaccuracies. Literature citations cover a very broad range and are up to date; again, variability exists between the various subjects and chapters.

In my mind, this volume has one substantial flaw: it presents a great deal of information gleaned from the literature without regard to its completeness. Some sections lack adequate synthesis. (Each chapter does end with a short summary, however, and this is usually quite helpful.) Although the authors warn that their book should be read critically, too often I find that students will view the information contained within a text as fact, perhaps without realizing the potential for misinformation. If you use this book for teaching purposes, bear in mind that the information that it contains must be reviewed, digested, and in some instances presented with caution. This style of presentation makes for an excellent reference book, and a reasonable text for graduate level phycologists, but will be difficult reading for an undergraduate. The volume lacks a glossary, which is another impediment to convenient use by undergraduates. In addition, the considerable attention to the current literature will quickly date this volume; a revision will be necessary in just a few years.

Overall, this is a very good book. Not many campuses offer a course in seaweed ecology; this volume may spawn some new ones. The material is well presented and its organization logical. Most botanists with an interest in seaweeds will benefit from its purchase. It will complement, not compete with, books already on the shelf.

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RAYMONT, J. E. G. 1980. Plankton and Productivity in the Oceans. Volume 1—Phytoplankton (Second edition). Pergamon Press, Oxford. 489 pp.

ROUND, F. E. 1981. The Ecology of Algae. Cambridge University Press, Cambridge. 653 pp.

Bartonia No. 52: 83–85, 1986

NEWS AND NOTES

1986 FIELD MEETING. The annual joint meeting of the Northeastern Section of the Botanical Society of America, the Philadelphia Botanical Club, and the Torrey Botanical Club will be held June 15 to 18, 1986, at Paul Smith's College. Paul Smith's College is located in the upper Adirondacks, on the shore of Lower St. Regis Lake. Accommodations are in dorms with private baths built for the 1982 Olympics. Additional standard dorm accommodations are available. Trips to sites of interest will be led by authorities on the Adirondack flora. Evening lectures will provide local background and history. Many historical and recreational facilities are located in the vicinity. Prior registration is advised. Information is available from Dr. Charles Burch, Aurora, NY 13026.

EASTERN PENNSYLVANIA NATURAL DIVERSITY INVENTORY 1985 FIELD HIGHLIGHTS. The Pennsylvania Natural Diversity Inventory (PNDI), a systematic and ongoing survey to collect and store, in a centralized data management system, information on Pennsylvania's native rare plants, animals, and exemplary natural communities, has been operating in eastern Pennsylvania since the fall of 1982. The PNDI uses the same methodology as employed by the thirty-nine other State Natural Heritage Programs located throughout the United States. To date information on 2800 element occurrences (sites) has been processed into our system, and of these 570 have been confirmed extant and 190 confirmed destroyed. Of the 1805 plant sites that have been processed, 390 have been confirmed extant and 160 confirmed destroyed.

In 1985 the Inventory conducted field surveys for several C2 Federal Candidate plant species in cooperation with the U.S. Fish & Wildlife Service. *Euphorbia purpurea* is currently known from approximately 20 sites in the eastern United States and had not been seen in Pennsylvania since 1962. The species was located in Chester, Cumberland, Perry, and York counties. The primary habitat is shaded calcareous to circumneutral seepage swamps. However it was found on moist stream banks at two sites including a Chester County serpentine barren.

September surveys conducted with A. E. Schuyler resulted in the discovery of two extant populations of *Scirpus ancistrochaetus*, another C2 Federal candidate species. A small population was found growing in mucky soil on the shaded margin of an acid basin marsh in Clinton County. A second site consisting of one mature plant was located in Lackawanna County. The plant was growing in an acidic depression in a ridgetop scrub oak barrens. Subsequent visits to the site failed to find additional plants, but apparent suitable habitat remains to be checked in the general area.

A few county records of interest include *Scirpus subterminalis* and *Utricularia geminiscapa* found in a series of acidic vernal sinkhole ponds in Franklin County. *Bouteloua curtipendula* was found for the first time in Juniata County, and large limestone sinkhole ponds yielded the first records for *Carex typhina* and *Scirpus purshianus* from Lycoming County.

The second known extant population of *Glyceria obtusa* in Pennsylvania was located in Monroe County near Long Pond. The only known extant population of *Ribes missouriense* in Pennsylvania, first collected by Wherry in 1965, was relocated in Cumberland County. The plants are thriving on a west facing shale slope in a wooded area that was apparently selectively logged sometime in the past ten years.

Cyperus difformis, a widespread species of southern Europe and the tropics of the eastern hemisphere, was collected and is reported for the first time in Pennsylvania. The plant was found in small numbers growing on sand and mud deposits in rock outcrops on the lower Susquehanna River, Lancaster County.

The Pennsylvania Natural Diversity Inventory is funded by the Pennsylvania Department of Environmental Resources, Bureau of Forestry through donations to the Wild Resource Conservation Fund and by The Nature Conservancy. We thank all the volunteers who provide information to the PNDI, for without their assistance the task of identifying and protecting the most endangered elements of Pennsylvania's natural heritage would be impossible. Voucher specimens for the species discussed above have been deposited in the author's personal collection, and duplicates will be deposited in the Academy of Natural Sciences of Philadelphia. THOMAS L. SMITH.

THE EDGAR THEODORE WHERRY COLLECTION. In the autumn of 1984 Anita Kistler proposed to this writer to collect the slides, correspondence and photos, of Dr. E. T. Wherry for inclusion in the library and archives of the Academy of Natural Sciences of Philadelphia for the benefit of students, researchers, and historians.

Approximately 1500 of Dr. Wherry's hand colored glass plate slides were discovered at the Morris Arboretum with the help of Robert Gutowski and others. With permission from Dr. William Klein the slides were brought to Dr. and Mrs. William Flook, Jr., whose volunteer efforts will convert these to 35 mm kodachrome slides retaining the color fidelity of the originals. Thanks to Dr. Huttleston of Longwood Gardens, to this collection will be added 400 35 mm copies of Dr. Wherry's glass slides to complete the collection. Dr. and Mrs. Flook will then prepare a catalog. One set of slides will remain at Morris Arboretum and another at the Academy. This portion of the project will be underwritten by the Delaware Valley Chapter of the American Rock Garden Society as a continuing memorial to Dr. Wherry.

Readers of Bartonia are familiar with the biographical sketch and tribute paid to Dr. Wherry by Dr. John M. Fogg, Jr., as well as the extensive Wherry bibliography prepared by Dr. Warren H. Wagner, Jr., and published in Bartonia No. 49. The latter contribution is paramount to the foundation of the Wherry collection. To this will be added a hundred or more citations which have since come to my attention.

Inquiries to the Library of Congress, the Smithsonian, and other institutions reveal the existence of thousands of letters which Dr. Wherry exchanged with men and women of science as well as with people from every walk of life. These will be reproduced and gathered together as soon as time and funds permit. There remains to be contacted hundreds of faculty members, universities, herbaria, arboretums, academies, museums, libraries, associations, authors, publishers, and private individuals before this collection can be thought complete.

One of the most valuable contributions thus far has been the hundreds of letters contributed by Dr. Wherry's friends, students, and associates whose names are too numerous to list here. These letters tell much about his unique personality and extraordinary range of knowledge, and confirm his contributions to science and devotion to education. But at this writing the highest priority must be given to collecting Dr. Wherry's remaining correspondence, still in your hands, in order to help build one of the Academy's premier collections. Your suggestions for expanding this search are needed. MILTON LADEN.

CRYPTOGAM STUDY GROUP. A small group of Philadelphia Botanical Club members meets on the first Tuesday of each month at 12 noon to 1 pm. Our purpose is to increase our understanding of mosses, liverworts, lichens, and fungi as well as to care for and document collections in the Academy of Natural Sciences and to provide a more comprehensive understanding of lower plant distribution in the Delaware Valley.

We have begun the systematic identification of moss and lichen families, emphasizing Sphagnaceae (C. Manville), Brachytheciaceae (A. Felton), and Cladoniaceae (K. Anderson). We hope to plan collecting trips during the coming year, with a possible focus on a specific area of eastern Pennsylvania. Our historical research will focus on previous bryological and lichenological work in the Delaware Valley by T. P. James, T. C. Porter, H. Muhlenberg, C. Austin, E. Moul, and others.

We invite the participation or correspondence of others interested in cryptogamic studies. If interested, please contact G. C. Greenland, A. Felton, or K. Anderson in the Botany Department, The Academy of Natural Sciences of Philadelphia, 19th & The Parkway, Philadelphia, PA 19103, (215) 299-1192. G. C. GREENLAND.

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1985 FIELD TRIPS

April 17: Wissahickon Creek, Fairmount Park, Philadelphia County, PA. Following the footsteps of many Philadelphia bryologists, including Thomas P. James, fourteen members enjoyed the early spring flora between Bells Mill Road and Valley Green. The search for bryophytes produced a list of 36 mosses and 6 liverworts growing along Wissahicken Creek. Leaders: Christine Manville and Anna Felton.

April 24: Tinicum Environmental Center, 86th Street and Lindbergh Boulevard, Philadelphia County, PA. Despite rain and low temperatures, we were able to find and examine the following moss and lichen species: *Physcia millegrana, Cladonia cristatella, C. coniocrea, C. chlorophea, C. capitata,* and *C. apodocarpa*. The survival of these species in an area of heavy pollution may be due to the cool air present at the soil surface that prevents the penetration of ''pollution ladden'' warm air to the lichens. The mosses observed were: *Fissidens taxifolius, Ceratodon purpureus, Dicranella heteromalla, Polytrichum commune,* and *Amblystegium riparium*. Leader: James K. McGrath.

April 20: Big Elk Creek, Chester County, PA. This was a joint trip between the Philadelphia Botanical Club and the Fern Society. We walked along the gravel road between the creek and a steep hill because of the species diversity found along the edges of the road. Many spring herbs were noted including *Anemonella thalictroides, Arabidopsis thaliana, Claytonia virginica, Dentaria laciniata, Epigea repens, Erythronium americanum, Pyrola rotundifolia, Ranunculus abortivus, Sanguinaria canadensis, Viola blanda, V. conspersa, V. cucullata, V. pensylvanica,* and *V. sororia*. Jack Holt prepared a more comprehensive list of species. Leaders: Dutch Huttleston and Charlotte Shaefer.

May 25: Huff's Church, Berks County, PA. A hundred and fifty acres of varied Berks County habitat, including four farm ponds, provided a count of about 150 species of native and naturalized flora including *Trillium, Polygala, Panax, Hydrastis, Trientalis, Carex* (*C. prasina* in abundance) and 14 species of ferns. We also appreciated Robert Seip's bounteous collection of rock garden plants and his nursery of selected cultivars of nuts and minor fruits. Leaders: Ann Newbold and Robert Seip.

June 22: New Lisbon, Pemberton Township, Burlington County, NJ. We hiked along the south shore of the North Branch of Rancocas Creek west of the Post Office and found a large stand of *Lygodium*. There, in a *Liquidambar-Nyssa-Acer* lowland, we found a dense stand growing over all adjacent small trees and shrubs. The stand covered a few acres with many small colonies seen throughout the walk area. It was an extraordinary find in an area with little chance of development. The species looked very healthy with many seedlings. In addition to *Lygodium*, other species found included *Aira caryophyllea, Echium vulgare, Carex stricta* var. *strictior, Lespedeza repens, Carex livida, C. longii,* and *Carya ovata*. Leader: Joe Arsenault.

July 6: Martha Furnace Area, Burlington County, NJ. In swales along an old stage route, *Carex barratti* and *Muhlenbergia torreyana* were encountered. In the vicinity of the furnace site, sharp eyes detected *Ophiglossum vulgatum* in fruit, *Carex cephalophora, Oxypolis rigidior* var. *longifolia,* and a fine cluster of *Monotropa hypopithys.* While orchid lovers were delighted to see in flower *Pogonia ophioglossoides, Calopogon pulchellus, Habenaria lacera,* and *H. clavellata* (the later tightly in bud), sedge hounds were equally enthusiastic about *Carex howeii, C. collinsii, C. swanii, C. folliculata, C. exilis,* and *Scirpus pungens.* On the bog mat interest focused on *Sabatia difformis, Utricularia cornuta, U. fibrosa, U. subulata, Lophiola americana, Schizaea pusilla, Lycopodium carolinianum, Narthecium americanum,* and *Tofieldia racemosa.* Species of *Sphagnum* identified in the field were *S. flavicomans, S. pulchrum, S. molle, S. bartlettianum, S. magellanicum, S. pylaesii,* and *S. cyclophyllum.* A brief stop at Harrisville gave all an opportunity to see a fine population of *Chrysopsis falcata,* a rare species that reaches its southern limit in the Pine Barrens. A contingent of hangers-on took a side trip to Burnt Bridge over the Wading River to admire *Carex livida, Juncus caesariensis, Solidage stricta,* and *Asclepias rubra.* Leader: Ted Gordon.

July 20: Bear Swamp West, Cumberland County, NJ. Two major habitats were studied: (1) two of the three extant clear, acidic ponds which have filled borrow pits made by the glass-sand mining industry earlier in the century, and (2) a remnant of apparently primary broadleaved swamp forest, dominated by huge specimens of *Nyssa sylvatica,* and *Liquidambar styraciflua.* In the oak-pine woods surrounding the swamp a single specimen of *Polygala mariana* was spotted by Michael Barnett. In one of the ponds, the site for *Potamogeton confervoides* was revisited where it occupies an extensive area of shallow water and continues to do well. In the primary forest, we visited a site with almost permanent pools of standing water which had a dense understory and specimens of *Nyssa* to an estimated thirty five meters in height dominating the canopy. Here there is a station for the mistletoe, *Phoradendron flavescens.* In a more open and drier area with no standing water present, the canopy dominant is *Liquidambar* with *Nyssa* as a co-dominant. Specimens of both species occur to heights of an estimated forty meters. Here the shrub layer consists primarily of *Ilex opaca.* Leaders: Stevens Heckscher and Dan O'Connor.

July 27: West of Bridgeport, and Worcester Township, Montgomery County, PA. We explored two separate sites under powerlines, the first a heavily degraded site ranging from sandy open ground to well-drained woodland ending in an overlook, the second a grassy to open bushy slope and low field. Oak species growing at the first site included: *Quercus alba, coccinea, marilandica, palustris, prinus, rubra,* and five specimens of *Q. falcata* at its second recorded station in Montgomery County. Specimens of *Q. falcata* and *Q. marlandica,* and apparent hybrids between these and other oaks were collected. Other unusual and locally rare species included *Asclepias viridiflora, Crotolaria sagittatis, Diodia teres, Hypericum gentianoides, Lespedeza capitata, Melilotus altissima, Helianthemum canadense, Plantago aristata,* and *Sericocarpus asteroides* in the sandy areas and on a bracken slope, and *Aristolochia serpentaria* and a single stalk of *Monotropa hypopithys* in the woods. In Worcester Township north of Norristown, we saw a number of garden escapes and persistent introductions along the edge of the paved road: *Acer campestre, Cornus mas, Miscanthus sinensis,* and an ornamental *Viburnum.* Down a dirt road under the powerline, we encountered *Asclepias viridiflora, Cornus racemosa, Habenaria lacera, Myrica pensylvanica,* and *Polygala* *sanguinea* and *verticillata*. A possible *Triadenum* colony was sought, but extensive mowing apparently destroyed it and many of the *Myrica* shrubs. Leader: Jack Holt.

August 25: Rancocas Nature Center, Westampton, Burlington County, NJ. On this trip to view late summer grasses, rudereals, and plants of a freshwater intertidal zone, the species we saw included *Uniola laxa, Eragrostis poaeoides, Triodia flava, Zizania aquatica, Hibiscus trionum, Magnolia tripetala, Acnida cannabina, Echinochloa walteri, Isoetes riparia, Scirpus smithii,* and *Fimbristylis autumnalis*. Leader: Karl Anderson.

September 7: Atsion and vicinity, Burlington and Atlantic counties, NJ. This trip was about two years after the "Great Fire." The grasses seen included *Amphicarpum, Calomovilfa,* and *Muhlenbergia torreyana*. Showy herbs included *Gentiana autumnalis, Prenanthes autumnalis, Lobelia canbyi, Gerardia racemulosa,* and *Solidago stricta*. The importance of forest fires on the flora of the Pine Barrens was well demonstrated. Leader: Jim Stasz.

September 8: Wading River tidal marsh, Wading River, NJ. This marsh, at the brackish-freshwater interface, has a mixed flora of salt tolerant plants and plants of freshwater marshes and swamps. We headed north from route 542 and walked through low marsh vegetation for about 100 meters before heading east to the river shore. In the upper parts of the marsh, *Phragmites* was abundant among dead *Chamaecyparis* trees. In more open areas we encountered *Rhododendron viscosum, Vaccinium macrocarpon, Aster nemoralis, Cladium mariscoides, Helenium autumnale, Bidens coronata, Aster novi-belgii, Lobelia cardinalis, Eryngium aquaticum, Sium suave, Lysimachia terrestris, Typha angustifolia, Nymphaea odorata, Osmunda regalis, Thelypteris palustris, Solidago sempervirens, Peltandra virginica, Amaranthus cannabinus, Eleocharis ambigens, Acorus calamus,* and *Pluchea odorata*. As we approached the river, large stands of *Spartina cynosuroides* were eventually replaced by large stands of *Scirpus pungens* lower in the intertidal zone. Stands of *Scirpus cylindricus, Zizania aquatica,* and *Spartina alterniflora* were also present near the river along with a few plants of *Orontium*. The incoming tide prevented us from searching for plants in the lowest part of the intertidal zone although we were able to see *Scirpus subterminalis* occurring abundantly as a submergent in the river. We unsuccessfully searched for *Aeschynomene virginica* in an area where about 35 plants were seen in 1984. Leader: Alfred E. Schuyler

September 14: Upper Perkiomen Park, Green Lane, Montgomery County, PA. Highlights among the more unusual species seen were *Aster sagittifolius, Cirsium altissimum, Solidago flexicaulis,* and *S. speciosa*. *Gentiana andrewsii* and *G. crinata* were lovely. Other species seen were *Andropogon scoparius* and *A. gerardii, Arthraxon hispidus, Eragrostis spectabilis, Sorgastrum nutans, Triodia flava, Panicum clandestinum* and *P. agrostoides, Carex squarrosa, Quercus bicolor, Eupatorium purpureum, E. fistulosa* and *E. perfoliatum, Solidaago caesia, S. bicolor, S. nemoralis, S. rugosa, S. gigantea, S. altissima, S. arguta, Lespedeza hirta* and *L. nuttallii, Gerardia pedicularia, G. tenuifolia, G. virginica, Aster cordifolius, A. prenanthoides, A. divaricatus, A. laevis, A. laterifolius, A. pilosus* var. *demotus,* and *Monotropa uniflora*. Leader: Mariana McCabe.

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1985	*Subject*	*Speaker*
24 Jan.	Mushrooms Through the Year—An Overview of Mycological Diversity	Rod Tulloss
28 Feb.	The Appalachian Gametophytes	James C. Parks
28 Mar.	The Natural History of Maryland's Nassawango Creek Watershed	James L. Stasz
25 Apr.	Plants and Their Habitats in the New Jersey Pine Barrens	Theodore Gordon
23 May	Review of Botany Club 1984–1985 Field Trips	James McGrath
26 Sep.	Members Report on Their Summer Activities	
24 Oct.	Winter Magic	Joseph M. Volk
21 Nov.	New Jersey Pine Barrens	Karl H. Anderson
19 Dec.	The Architecture of Trees	Benjamin C. Stone

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150 Years of Vegetation Change in Chester County, Pennsylvania

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Dr. William Darlington published his first flora of the West Chester area in 1826, expanding it to a county flora in 1837, with a final revision in 1853. With considerable reference to Darlington's work, Hugh Stone published his flora of Chester County in 1945. In 1979 the Atlas of the Flora of Pennsylvania (Wherry, Fogg, and Wahl 1979) was published which includes many recent plant records for the county since 1945. In 1982, as a contribution to the bicentennial celebration of Dr. William Darlington's birthday held at West Chester University, the author compiled and annotated a checklist of Chester County flora using data from Darlington, Stone, and Wherry et al. plus his own field experience in the county since 1963. This was subsequently published in Bartonia (Overlease 1986).

Such a careful record of over 150 years of a county's flora is unique and offers the present day botanist an opportunity to compare changes that have occurred. This paper is an interpretation based on these records and the author's personal experience and studies in the county for over 20 years.

Chester County is a large county of 762 square miles with a varied geology in terms of bedrock formations (Heivly et al. 1973). This has resulted in a variety of landforms, soil types, soil profiles, rock outcrops, and the unique areas of serpentine rock with their very special flora (Byler 1963). The result of all this variability of habitat is probably the richest flora of any county in Pennsylvania with over 1700 named species, varieties, forms, and hybrids (Overlease 1986).

In order to develop an up-to-date picture of the variability and abundance of plant species from site to site and the resulting differences in plant communities, it was decided to sample vegetation for each major surface geological formation throughout the county. Careful plant community notes were made throughout the county for each formation and are on file in the author's library. This field work involved over 80 field trips covering three years, 1981–1983.

The results of the survey gave a reasonably good picture of the major plant communities of the county and their variability and also a good abundance record for common and frequent plants. It was found that except for the unique plant communities on serpentine and possibly the mostly destroyed communities on limestone, that plant communities and flora distribution were primarily related to a moisture gradient.

With this broad outline of the major plant communities of the county, I will discuss each community in terms of its probable original vegetation and the changes that have occurred in the last 150 years.

XERIC FOREST COMMUNITIES

HYPOTHESIZED ORIGINAL FOREST COMMUNITIES. Xeric forest communities were found on shallow, well-drained soils on a variety of geological formations forming

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ridges and steep slopes as well as very permeable soils on more level topography. The geological formations included various kinds of gneisses, schist, conglomerate, quartz, monzonite, triassic sandstone (on some of the more level areas), and especially quartzite (Heivly et al. 1973).

The original community appears to have been an oak-chestnut dominated forest with *Quercus velutina, Quercus coccinea, Quercus prinus, Quercus alba,* and *Quercus rubra,* some *Liriodendron tulipifera,* considerable *Castanea dentata,* and more *Fagus grandifolia* than is evident today. *Acer rubrum, Nyssa sylvatica,* and *Cornus florida* were common understory trees. A shrub stratum was conspicuous with *Viburnum acerifolium, Kalmia latifolia, Vaccinium* spp., and *Rhododendron periclymenoides* being the most common (Nerukar 1974; Overlease 1973b, 1978; Gordon 1941).

There appears to have been a fairly well developed litter layer except on wind blown slopes. Due to the dry and exposed habitat, natural fires were probably more common than among other communities.

The herbaceous flora strata was not conspicious. *Cypripedium acaule* was not common (Darlington 1853).

CHANGES IN THE XERIC FOREST IN 150 YEARS. These forests appear to have been primarily clear-cut with second, third, or fourth growth stands of today being the result of stump sprouts and therefore similar in composition to the original forests. *Castanea dentata,* a most prolific sprouter, probably increased. In some communities it made up over 50 percent of the canopy (Nerukar 1974). Farm lands that had been cleared and eventually abandoned on these sites were represented by communities dominated by *Liriodendron* that was able to seed in.

From what I can piece together from old-timers and other general sources, ground fires, generally intentionally set, were a regular and normal part of the recent one hundred year history of these forests. There was little attempt at control as fires were considered useful to "improve," to "open up," and to "clean up" the woods.

This has resulted in a selection process forming a community of species that can survive frequent ground fires, especially species that sprout prolificaly from roots after the tops are killed. These include *Cornus florida, Viburnum acerifolium, Vaccinium* spp., and *Rhododendron periclymenoides*. Though the shrub stratum has probably always been conspicious in these forests, it is even more so today. Thin barked trees such as *Fagus grandifolia* became localized on more protected slopes and hollows and where litter did not accumulate on some wind blown slopes. *Betula lenta,* which was rare (Darlington 1853), has become frequent and even locally abundant, especially in the northern part of the county (Nerukar 1974; Overlease 1973b, 1978; Gordon 1941).

With a reduction of the litter layer due to frequent burning, certain herbaceous species such as the *Cypripedium acaule* have become locally frequent to common. The herbaceous stratum as a whole, however, shows little evidence of change and is still inconspicious.

Recent protection from ground fires in the last 20 to 30 years has resulted in local populations of beech saplings becoming more common.

The chestnut blight (*Endothia parasitica*) eliminated *Castanea dentata* as a crown cover species by around the early 1930's though live root sprouts are still common today. The result of the blight has been an increase in dominance by oak species, primarily *Quercus prinus, Q. velutina* and *Q. coccinea.*

The recent infestation of the county by the gypsy moth and the larva's preference for oak leaves may cause considerable changes in the future of these oak dominated forests. Weakened and large old growth oaks appear to be particularly susceptible to being killed by defoliation. Locally, on certain xeric sites, I have observed that nearly all oaks of various sizes have been killed. This included *Quercus velutina, Q. alba, Q. rubra,* and *Q. prinus.*

XERIC FORESTS ON SOILS FORMED FROM SERPENTINE ROCK. There appears to be a series of plant communities related to the variability of serpentine rock and the variation in the soils that develop on them. The relationships are not clear, and it is an area of continuing interest and research. It has been my experience that the presence or absence of well developed oak forests on serpentine is related to soil depth. On the shallow soils of upper slopes and the tops of upland area formed by serpentine are found the typical grassland serpentine barrens. On the slopes and where deeper soils develop, oak forests are found with *Quercus velutina, Q. alba,* and *Q. rubra* and considerable greenbrier (*Smilax glauca* and *Smilax rotundifolia*).

Transitions and variations between these two communities include various mixtures of grasses, *Quercus stellata, Quercus marilandica, Quercus ilicifolia, Quercus prinoides,* and locally *Pinus rigida.*

Serpentine sites that have not been severely disturbed by building or plowing, or other human activities, have remained relatively stable until recent years. The introduced *Robinia pseudo-acacia* has become a serious competitor on the grassland barrens. Unless controlled, it will spread and shade out the grassland species. Many other weedy species have become established on both disturbed and undisturbed barrens but have not become a serious competitor with the original vegetation.

Many rare and unusual plants of Chester County are found on the serpentine barrens. Some examples are *Talinum teretifolium, Bouteloua curtipendula, Sporobolus heterolepis,* and *Campanula rotundifolia.*

MESIC FOREST COMMUNITIES

HYPOTHESIZED ORIGINAL FOREST COMMUNITIES. These forests were found on level to rolling topography and on middle and lower slopes of ridges. They were found on a variety of rock formations including gabbroic gneiss, grano-diorite, granite gneiss, diabase, anorthosite, Wissahickon schist, and schists in general (Heivly et al. 1973).

The community had a wider range of tree species than the xeric forests with *Quercus velutina, Q. alba,* and *Q. rubra, Castanea dentata, Fraxinus americana, Liriodendron tulipifera, Carya ovata, Carya tomentosa,* and *Carya cordiformis. Fagus grandifolia* was the most common tree of the canopy (Overlease 1973b, 1978). There was no conspicious shrub stratum except in successional communities. Early travelers often commented on the openness of these forests. "A cart could easily travel anywhere" (Cobb 1983). *Cornus florida* was not conspicious. There was a well developed litter layer and the herbaceous ground flora was conspicious.

CHANGES IN THE MESIC FOREST COMMUNITY IN 150 YEARS. Originally, this forest covered well over half of the county. Much of it was cleared for farmland, towns, and villages and recently for real estate developments. Ground fires appear to have been frequent in this community as well as in the xeric forests. The chestnut blight eliminated *Castanea dentata* as a crown cover species by the 1930's. The recent gypsy moth infestations have resulted in the death of oaks in this community especially in some of the successional communities that tend to have more oak.

Due to repeated cutting and culling and frequent ground fires, many of these forests today resemble xeric oak forests with a conspicuous shrub stratum and an abundance of

Cornus florida (Overlease 1973a, 1978). The herbaceous ground flora however, is generally very evident. *Liriodendron, Quercus velutina, Q. alba,* and *Q. rubra, Fraxinus americana,* and *Carya* spp. are common. It appears that with the virtual elimination of ground fires in recent years that young thin barked trees such as *Fagus grandifolia* and *Acer platanoides* have been able to survive in considerable numbers (Overlease 1973b, 1978). A characteristic of this forest today is the abundance of *Fagus grandifolia* in the understory as saplings and seedlings and also in many areas large numbers of seedling and sapling *Acer platanoides* (Overlease 1973b, 1978). Some fine beech dominated forests, similar to the original forests, are still found on relatively undisturbed sites. There are no virgin forests.

As *Fagus grandifolia* returns to its former dominance of the crown canopy with the resulting deep shade, shrub species will become less conspicious and the understory tree species, *Cornus florida,* will also become reduced. The open understory of the original forests will again be evident. The presence of the very shade tolerant *Acer platanoides* in many of these communities will speed these changes.

Liriodendron has become dominant in many of the disturbed forests, especially where *Castanea dentata* was common and was eliminated by the chestnut blight (Overlease 1973a, 1978). This is in contrast to xeric sites where oak species replaced *Castanea dentata*. *Liriodendron* is also one of the most common pioneer tree species on mesic sites seeding in on abandoned farms along with *Fraxinus americana, Prunus serotina,* and *Cornus florida* (Overlease 1969, 1973a).

Weedy woody shrubs have become very abundant in many successional and severely disturbed forests. *Lonicera japonica* and *Celastrus orbiculatus* are severe pests often forming thick tangles that prevent young trees from developing properly. Herbaceous weeds are generally not common except on severely disturbed sites.

Many species of the more sensitive herbaceous plants that were once frequent in this community have now become rare. Ground fires severely effecting litter conditions and the drying of the sites due to logging and culling appear to be the main reasons for these changes. Some of the litter dependent species include *Corallorhiza maculata, Corallorhiza odontorhiza, Triphora trianthophora,* and *Orobanche uniflora* (Darlington 1853; Stone 1945; Overlease 1986). *Aplectrum hyemale,* never very common in the county, has become rather rare (Overlease 1986). It has an unusual winter green leaf that would be easily killed by ground fires. *Cypripedium calceolus* var. *pubescens* was stated as ''formerly frequent'' by Darlington in 1853. It is now quite rare (Overlease 1986). *Panax quinquefolius* had already become uncommon by the early 1780's due to the interest in collecting it for the foreign markets (Letter from Humphry Marshall, 1786, in Darlington 1849).

SWAMP FOREST COMMUNITIES

HYPOTHESIZED ORIGINAL FOREST COMMUNITIES. Swamp forests were found on soils with a clay hardpan that prevented water drainage. Very wet soils and standing water in the spring were typical. Because of the impermeable clay hardpan, trees had shallow root systems and windthrow was frequent. *Quercus palustris, Acer rubrum, Quercus bicolor,* and *Nyssa sylvatica* were common canopy species. The shrub stratum was well developed with *Lindera benzoin, Viburnum dentatum, Viburnum prunifolium, Ilex verticillata,* and *Cornus amomum.* Along swamp forest edges and young open marsh successional communities, *Alnus serrulata* was common and *Toxicodendron vernix* frequent. *Symplocarpus foetidus* was a generally conspicious understory herbaceous plant. The herbaceous flora was not well developed on wet shady sites but could become conspicious on better drained sites and on mounds and hummocks.

CHANGES IN THE SWAMP FOREST IN 150 YEARS. Today, there are no undisturbed swamp forests in the county. They have been drained, partially drained, repeatedly cut, or cleared and the soil scalped for clay for commercial uses. The patches and remnants of today are dominated by *Acer rubrum* with *Quercus palustris* common and some *Nyssa sylvatica* and *Quercus bicolor*. Locally, swamps dominated by *Quercus alba* and *Carya ovata* are found and one relic swamp in northern Chester county has survived that has native white pine (*Pinus strobus*). The shrub stratum is similar to the original forests in being conspicious but with the addition of new weedy species especially *Lonicera japonica* and *Celastrus orbiculatus*. The herbaceous understory appears similar to the original forests with herbaceous weeds generally not conspicious except in very severely disturbed sites. In recent years, as compared to fifty years ago, the canopy has developed in many young successional stands resulting in *Toxicodendron vernix* and *Alnus serrulata* becoming more local and less common.

FLOOD PLAIN FOREST COMMUNITIES

HYPOTHESIZED ORIGINAL FOREST COMMUNITIES. Flood plain forests were found along streams on alluvial soils that had generally good drainage except locally where clay lenses were deposited. They were especially well developed along Brandywine creek and along the Schuylkill river. They were rich mesic forests with trees of large size (Overlease 1983). The common species included *Quercus rubra, Q. alba, Fagus grandifolia, Fraxinus americana, Fraxinus pennsylvanica* var. *pennsylvanica, Juglans nigra, Juglans cinerea, Ulmus rubra, Prunus serotina, Carya cordiformis*, and *Carya ovata* (Overlease 1983). *Quercus palustris* and *Acer rubrum* were found on the wet soils developed on local clay lenses. *Carpinus caroliniana* was a common understory tree. The shrub stratum was well expressed with *Lindera benzoin, Cornus amomum, Toxicodendron radicans* var. *radicans,* and *Vitis* spp.

The herbaceous flora was rich in species and very conspicious especially *Claytonia virginica*.

CHANGES IN THE FLOOD PLAIN FORESTS IN 150 YEARS. Because of the rich deep soils found on the flood plain, they were cleared early and used for farming. In recent years since the depression of the 1930's and World War II, they have been abandoned and are returning to forest communities again. It is the most changed of all forest communities in Chester County. *Acer saccharinum*, which was rare 100 years ago (Darlington 1853), is the dominant tree of the blood plain forests today (Overlease 1983). Both *Fraxinus pennsylvanica* and *americana* are common as are *Juglans nigra, Ulmus rubra,* and *Carya cordiformis*. *Juglans cinerea* is only occassionally found today but was frequent in Darlington's day. *Acer negundo* is an abundant tree, primarily in the understory. It was uncommon 1853 (Darlington 1853). *Ulmus rubra* is a common tree today but many have been killed by the Dutch Elm disease. *Ulmus americana* was never common and is rare today. It is particularly susceptible to the Dutch Elm disease.

The shrub stratum contines to be conspicious but with the addition of non-native weedy shrub species such as *Lonicera japonica, Rosa multiflora, Ligustrum vulgare,* and *Celastrus orbiculatus*. Occasionally ornamental shrubs become established such as *Euonymus alatus, Viburnum plicatum,* and *Berberis thunbergii*.

The herbaceous flora is similar to the rich original flora dominated by spring beauty with the addition of many new weedy species. Examples include *Ornithogalum umbellatum, Glechoma hederacea, Alliaria petiolata, Alluim vineale, Humulus japonicus, Hesperis matronalis,* and in recent years, *Ranunculus ficaria* and *Microstegium vimineum.* Dr. Darlington reports *Mertensia virginica* as frequent. Stone in his flora in 1945 says "common above Chadd's Ford, rare elsewhere in county." It is locally common along many portions of the Brandywine today. Its populations appear to have been reduced by the use of the flood plain for farming but as the flood plain forests have become re-established the blue bells have returned in possibly larger numbers than originally found.

Open Marshes and Moist Meadows

These communities are dominated by grasses, sedges (*Carex* spp., *Scirpus* spp.) and rushes (*Juncus* spp.), and locally by *Typha latifolia, Cephlanthus occidentalis,* and willows (*Salix* spp.). They are generally successional to swamp forest and flood plain forests. They became common with the clearing of the forests and the use of moist meadows for pasture and hay. In recent years since Stone published his flora in 1945, *Conium maculatum, Lythrum salicaria,* and *Amorpha fruticosa* have become locally common in these habitats. Due to disturbance, many species that were once frequent, such as *Gentiana andrewsii* and *Gentiana crinata,* have become rare and *Castilleja coccinea* has been extirpated.

Bogs

This is one of our rarest habitats in Chester County. I have only seen small relics and local patches of bog-like conditions but no fully developed bog. With draining of low areas, clearing of the forests, grazing of moist open areas, the bogs, which were small and few to begin with, have virtually disappeared. The sensitive bog orchid, *Arethusa bulbosa,* was last seen in 1852. This probably indicated the last of any well developed bogs in the county. Several interesting and rare bog species have occasionally been found in the few small relic areas remaining such as *Calopogon pulchellus, Vaccinium macrocarpon,* and *Pogonia ophioglossoides.*

New Plant Communities

One of the most dynamic and interesting results of the settlement and development of Chester County by the European settlers has been the many new plant communities that have resulted. These include communities along roadsides, alleyways, vacant lots, abandoned fields, cultivated fields and gardens, dumps, railroad roadbeds, and many other kinds of unique local habitats.

Aggressive native and mostly European plants have moved into these habitats and given us the complex roadside–disturbed site flora of today. Actually our roadsides have become gardens of these interesting and often quite colorful wild plants. It is difficult to generalize on these communities as there are so many variables such as site soil stability, moisture and nutrient conditions, degree of disturbance, regularity of disturbance, use of herbicides, etc.

Old fields that have had corn planted and harvested on them are generally predictable changing from annual grass the first year, usually *Setaria faberi, Aster pilosus* var. *demotus* the second year, followed by *Solidago altissima* for the next fifteen to twenty years until shrubs and small trees shade out the herbaceous plants (Overlease 1969, 1973a).

Our four most aggressive weeds today dominating many local sites, are *Lonicera japonica, Celastrus orbiculatus, Cirsium arvense,* and *Rosa multiflora.*

To illustrate the dynamic nature and the speed of change related to the weed flora are several examples from only the last 20 years of observation in this county. I have seen *Alliaria petiolata* change from a very local plant on the Bradywine flood plain twenty years ago to a very common, locally abundant plant in the county today. *Ranunculus ficaria* has become fairly common in the county in just the last 5 to 8 years. The same is true with *Microstegium vimineum.* It seems to have exploded over much of the county in the last 5 years, entering even relatively undisturbed communities. *Pueraria lobata* has not been aggressive in the county so far. Only a few stations are known. Bob Powers, the Chester county agriculture agent for many years, reports (pers. comm.) watching one colony for over 30 years with little change. A weed pest that appears on the verge of becoming a real problem in the county is *Sorgum halepense.* It has been present for several years but is now becoming locally conspicious. There is one very recent station for the aggressive viny knotweed, *Polygonum perfoliatum,* in the county. However, it has been found spreading aggressively in nearby Delaware county. One last example of how the weed flora can change quickly: Bob Powers (pers. comm.) reported that when complete fertilizers were introduced in the county in the 1950s, mustards became much more common in the fields.

Tables 1 and 2 give a summary of some of the changes in abundance of selected weed species over the last 150 years. Table 3 lists the earliest collection date on specimens in the Darlington Herbarium.

TABLE 1. Selected weed species that have obviously changed in abundance from publication of William Darlington's *Flora Cestrica* (1853) to Hugh Stone's *Flora of Chester County* (1945).

Name of Plant	Abundance in Darlington's 1853 flora	Abundance in Stone's 1945 flora
Aegopodium podagraria	Not recorded	Frequent
Rubus phoenicolasius	Not recorded	Frequent
Trifolium hybridum	Not recorded	Common
Lysimachia nummularia	Not recorded	Common
Perilla frutescens	Not recorded	Locally abundant
Lonicera japonica	Not recorded	Common
Ailanthus altissima	Streets and about houses	Frequent
Medicago lupulina	Rare	Frequent
Melilotus officinalis	Not recorded	Frequent
Sicyos angulatus	Some gardens	Frequent
Lepidium campestre	Rare	Frequent
Duchesnea indica	Not recorded	Rare in Stone Frequent in county in 1982 (Overlease 1986)
Nasturtium officinale	Found in 1838, naturalized in several localities in 1853.	Frequent
Cuscuta epilinum	Formerly a great pest among the flax crops . . . spoiling large quantities. Since culture has declined . . . become quite rare (1853).	Stone found no Chester County specimen.

TABLE 2. Selected weed species that have obviously changed in abundance since the publication of Stone's *Flora of Chester County*, 1945.

Name of Plant	Abundance in Stone's 1945 flora	Present abundance (Overlease 1986)
Humulus japonicus	Rare	Frequent, locally abundant
Morus alba	Occasional	Common
Berberis thunbergii	Rare	Frequent
Celastrus orbiculatus	Not recorded	Locally abundant
Rosa multiflora	Not recorded	Common
Lonicera morrowii	Rare	Frequent
Amorpha fruticosa	Rare	Frequent, locally abundant
Acer platanoides	Occasional	Common
Ligustrum vulgare	Sparingly escaped	Frequent
Elaeagnus umbellata	Not recorded	Frequent
Rhus typhina	Rather rare	Fairly frequent
Setaria faberi	Not recorded	Common
Phragmites australis	Very rare	Frequent
Microstegium vimineum	Not recorded	Common, locally abundant
Sorgum halepense	Not recorded	Occasional
Carduus nutans	Rare	Fairly frequent, locally abundant
Duchesnea indica	Rare	Frequent
Lythrum salicaria	Rare	Fairly frequent, locally abundant
Thlaspi arvense	Rare	Frequent
Alliaria petiolata	Rare	Common, locally abundant
Conium maculatum	Local	Common, locally abundant
Lamium purpureum	Rare	Common
Lamium amplexicaule	Frequent	Occasional
Aster novae-angliae	Rather Rare	Frequent
Coronilla varia	Not recorded	Frequent, commonly planted along roadsides
Ranunculus ficaria	Not recorded	Frequent, becoming locally abundant
Tussilago farfara	Not recorded	Occasional
Hesperis matronalis	Rather Rare	Common
Convolvulus arvensis	Rather Rare	Frequent, locally abundant

RARE PLANTS OF CHESTER COUNTY

One of the most interesting problems with the vegetation of the county is the discovery and recording of rare plants. Table 4 gives a summary of the relationship of rare and rather rare plants of Chester County for the county flora of 1757 named entities (Overlease 1986).

As can be seen from the figures, nearly half of the flora of the county in terms of species and named entites (hybrids, variants, etc.) are rare or rather rare. There are many reasons for plants being rare in the county even though they may be common in other counties of Pennsylvania or in nearby states. Some plants are at their southern range limits (*Platanthera orbiculata, Polygala paucifolia*). Others are at the northern edge of their range and thus are rare (*Tipularia discolor, Chionanthus virginicus*). The elimination or reduction of habitats such as bogs and moist forested limestone slopes (See Table 5 for examples) has occurred. Some species grow in very local specialized habitats such as moist limestone ledges (*Cystopteris bulbifera*), serpentine barrens (*Talinum teretifolium*), and cold springs and seeps (*Cardamine rotundifolia*). Drying and reduction of the quality of habitat has affected such litter dependent species as

TABLE 3. Some early dated herbarium specimens of weeds of Chester County found in the Darlington Herbarium West Chester University

Achillea millefolium—1827. *Arabidopsis thaliana*—1837. *Aralia spinosa*—near Marshallton, 1828. *Barbarea vulgaris*—West Chester 1827. *Brassica kaber* var. *pinnatifida*—1837. *Brassica nigra*—West Chester 1827. *Capsella bursa-pastoris*—West Chester 1828. *Cenchrus pauciflorus*—1833. *Chelidonium majus*—West Chester 1828. *Chenopodium album*—West Chester 1828. *Cirsium arvense*—Warren Tavern 1828 "was introduced 6 years ago," quote from label with specimen. *Datura stramonium*—West Chester 1827 "very common." *Daucus carota*—West Chester 1832. *Dipsacus sylvestris*—near West Chester 1828. *Galium aparine*—West Chester 1828. *Glechoma hederacea*—1828. *Leonurus marrubiastrum*—1829. *Linaria vulgaris*—West Chester 1827. *Lithospermum arvense*—West Chester 1827. *Malva neglecta*—West Chester 1828. *Morus alba*—1828. *Nepeta cataria*—West Chester 1827. *Ornithogalum umbellatum*—West Chester 1830. *Papaver dubium*—Downingtown 1835. *Perilla frutescens*—1861. *Physalis heterophylla*—West Chester 1828. *Physalis subglabra*—1835. *Polygonum aviculare*—West Chester 1829. *Polygonum convolvulus*—West Chester 1830. *Polysonum persicaria*—1828. *Polygonum scandens*—1830. *Portulaca oleracea*—1829. *Prunella vulgaris*—1827. *Ranunculus bulbosus*—1831. *Rumex acetosella*—1828. *Rumex crispus*—1827. *Rumex obtusifolius*—1828. *Saponaria officinalis*—West Chester 1827. *Senecio vulgaris*—"introduced within the last 4 or 5 years and now becoming abundant. Green Tree yard, May 10, 1849. Probably introduced by the Drove Cattle." Note on herbarium label. Stone records no specimen in his 1945 flora. It is rare today. *Sicyos angulatus*—1829. *Sisymbirum officinale* var. *leiocarpum*—1828. *Solanum carolinense*—West Chester 1827. *Solanum dulcamara*—1829. *Stellaria media*—1817. *Verbascum blattaria*—West Chester 1827. *Verbascum thapsus*—West Chester 1827. *Verbena urticifolia*—1827. *Veronica arvensis*—1838. *Veronica hederaefolia*—1831. *Veronica officinalis*—West Chester 1826. *Veronica peregrina*—West Chester 1826. *Veronica serpyllifolia*—West Chester 1826.

Corallorhiza maculata, Corallorhiza odontorhiza, Corallorhiza wisteriana, and *Orobanche uniflora*. Other kinds of rare plants include introductions that have not become well established (*Nymphoides peltata, Pueraria lobata*), weedy plants that once were locally common but are now rare (*Senecio vulgaris*), and garden escapes that have not become well established (*Taxus cuspidata, Euonymous europaeus*). Finally, some plants have been collected extensively for commercial or local medicinal use (*Panax quinquefolius, Hydrastis canadensis*).

After extensive search, including the efforts of many botanists over the last 100 years, 47 species of plants are presently thought to be extirpated from the county. These are listed in Table 5.

ACKNOWLEDGMENTS

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TABLE 4. Summary of the flora of Chester County, Pennsylvania, including rare and rather rare plants.

	Number of named entities	Number of extirpated rare, or rather rare entities	Percent extirpated rare, and rather rare entities
Ferns and fern allies	71	39	55%
Gymnosperms	13	11	85%
Monocotyledons	462	259	56%
Dicotyledons	1211	624	52%
	1757	933	53%

TABLE 5. A list of plants believed to be extirpated from Chester County, Pennsylvania

Name of Plant	Last Recorded	Notes
Asclepias rubra	1830	southern plant at north edge of range
Arethusa bulbosa	1852	northern bog species
Asplenium ruta-muraria	1928	very local on limestone, probably extirpated by local plant collectors
Brasenia schreberi	1836	very local in Pennsylvania
Bupleurum rotundifolium	1827	reported as naturalized in several neighborhoods, West Chester (Darlington 1853)
Carex plantagenia	1866	at southern limit of range in Pennsylvania
Coeloglossum viride v. *bracteatum*	1833	northern plant, Great Valley, probably a rich woods on limestone
Corallorhiza trifida	1831	collected at Black Rock, 1831, and East Goshen, both specimens are in Darlington Herbarium
Cuscuta epilinum		"becoming quite rare. Formerly great pest among flax crops" (Darlington 1853)
Descurania pinnata	1836	Black Rock
Galactia regularis	1829	more southern plant, Valley Hill
Gaylussacia dumosa	1852	sandy woodlands, West Nottingham
Geum rivale	1835	northern plant found by cold spring area
Houstonia purpurea v. *longifolia*	1836	Chestnut Hill, Chester County; a more western species in Pennsylvania
Hybanthus concolor	1841	very local, moist limestone slope
Iris prismatica	1907	coastal plain species
Liatris scariosa	1852	East Nottingham collected by Evan Pugh; a more western species in Pennsylvania
Leucothoe racemosa	1830	several stations east of Chester County in Delaware and Philadelphia counties
Lippia lanceolata v. *recognita*	1836	very local species in Pennsylvania, Coventry Township; mostly southern in our region
Listera australis	1850	southern species very local northward; only two records for Pennsylvania (Wherry et al. 1979)
Lithospermum canescens	1833	Great Valley, Brook's Mill; a more western species in Pennsylvania
Lonicera canadensis	1865	Cliffs of Schuykill River, Phoenixville; probably at Black Rock; listed at Tunnell Hill
Lycopodium inundatum	1848	collected by Vincent Barnard; specimen in Darlington Herbarium
Lysimachia lanceolata	1836	Coventry township; a more western species in Pennsylvania
Marrubium vulgare		a more southern weedy, naturalized species; no date, West Chester; collected by William Darlington
Oryzopsis racemosa	1894	on limestone rock; site since destroyed
Parthenium hesterophorus	1857	weed from south America, mostly southern
Phlox divaricata ssp. *divaricata*	1831	Black Rock; a western species in Pennsylvania
Phoradendron serotinum		referred to as very rare by Darlington (1853); reported by early settlers to Darlington
Physostegia virginiana v. *granulosa*	1836	Schuykill; mostly western in Pennsylvania

TABLE 5. Continued.

Name of Plant	Last Recorded	Notes
Platanthera peramoena	1836	Pigeon Creek
Polygala incarnata	1851	East Nottingham, collector Evan Pugh; southern plant in our region; only two records for Pennsylvania (Wherry et al. 1979)
Polymnia uvedalia	1836	moist limestone slope; local in Pennsylvania
Pontederia cordata	1829	Black Rock
Populus heterophylla	1828	new State record
Ranunculus hederaceus	1929	only Pennsylvania locality
Ranunculus pusillus	1831	near French Creek Bridge, Pikeland; more western species in Pennsylvania
Ranunculus reptans v. *reptans*	1836	Schuykill; very local in Pennsylvania
Rhynchospora alba	1828	more northern in Pennsylvania; a bog species
Rotala ramosior	1837	very local in Pennsylvania
Salix lucida	1828	Brandywine near Downingtown; more northern species in Pennsylvania
Samolus parviflorus	1830	Great Valley near Baptist Meeting House; locally north in Pennsylvania
Sium suave	1835	Brandywine; more northern species in Pennsylvania
Smilacina stellata	1830	very local in Pennsylvania
Solidago speciosa	1833	Pennsylvania records more northerly and westerly
Sparganium chlorocarpum v. *chlorocarpum*	1836	Joseph Rinehart, Wynn's Meadows; more northern in Pennsylvania
Spartina pectinata	1829	Black Rock; local in Pennsylvania
Taxus canadensis	1929	Phoenixville site and area have been carefully surveyed; no specimens have been found; very local
Trifolium reflexum	1866	near Phoenixville
Triosteum angustifolium	1852	East Nottingham, collected by Evan Pugh; few records in Pennsylvania north and west of county
Utricularia vulgaris	1829	stagnant pools, Brandywine
Veronica scutellata	1829	northerly and westerly distribution in Pennsylvania
Woodsia ilvensis	1829	Black Rock; northern plant at southern edge of range

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Shale Barren Ragwort (*Senecio antennariifolius,* Asteraceae) in the Great Valley, Franklin County, Pennsylvania

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On 24 May 1984 I discovered a population of *Senecio antennariifolius* Britton five kilometers northwest of Greencastle in Franklin County, Pennsylvania. This population ("site A") consists of about 47 individuals. Another population ("site B") was found on 27 March 1986. It is 229 meters southeast of site A and consists of 613 individuals. Both sites are owned by the Greencastle Sportsmen's Association. Voucher specimens are on deposit at the Shippensburg University Herbarium.

The sites occur on the western edge of the Great Valley Section of the Valley and Ridge Province at an elevation of 152 meters. The parent substrate is Ordovician shale of the Martinsburg Formation (Root 1968). The associated soil is the Weikert shaly silt loam (Long 1975) on a southwest slope of 10 to 35 degrees. The base of the slope is 87 meters northeast of the Conococheague Creek, but the populations are an additional 52 meters uphill. The dominant herbaceous species are *Scleranthus annuus, Plantago aristata,* and *Senecio antennariifolius*. There are no woody species on site A, but *Pinus virginiana* is dominant on site B. The additional species that were observed within the sites are listed in the appendix.

Site A is not a natural shale barren but occurs in a lawn and has about 5% total plant cover by visual estimate. The exposed shale is about 360 square meters in area. Site B consists of disturbed vegetation with about 75% plant cover in an area of approximately 0.4 hectare.

Senecio antennariifolius ranges from south-central Pennsylvania southwestward within a relatively narrow band through Maryland, West Virginia, and Virginia to Montgomery County, Virginia (Keener pers. comm.; Brown and Brown 1984; Strausbaugh and Core 1977; Harvill et al. 1981). Keener (1983) considers it a shale barren holoschizoendemic. Sites A and B described above constitute the northeastern-most known locality for this species and are outside the previously delineated extent of the mid-Appalachian shale barrens (Keener pers. comm.). The species has not previously been reported from Franklin County, Pennsylvania. Only two other populations are known in Pennsylvania. They occur on shale barrens in the Appalachian Mountain Section of the Valley and Ridge Province in Fulton County and are 32 kilometers NW/WNW and 51 kilometers W/WSW from the two populations in Franklin County (Davison 1985; Wherry et al. 1979).

The species is considered officially "endangered" in Pennsylvania (Wiegman 1986), "uncommon" in Maryland (Boone 1984), and "rare" in Virginia (Porter 1979). In Maryland there are 30 to 40 stations in the Valley and Ridge Province, but the only known population in the Great Valley was destroyed when Interstate 70 was built along the Potomac River (Boone pers. comm.). *Senecio antennariifolius* is a regular component of shale slopes in the Appalachian Mountain Section (as described by Fenneman 1938) of western Virginia. It also occurs in the Massanutten Range and on Fort Lewis Mountain, which lie in the Great Valley (Wieboldt pers. comm.). In West Virginia there are 17 documented stations in seven counties in the Valley and Ridge Province (West

Virginia Wildlife/Heritage Data Base) and no stations in the Great Valley (Bartgis pers. comm.).

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APPENDIX

Other species at the Franklin County sites for *Senecio antennariifolius* are the following (nomenclature follows Kartesz and Kartesz 1980): *Acer negundo, Achillea millefolium, Ailanthus altissima, Allium vineale, Ambrosia artemisiifolia, Arenaria serpyllifolia, Aristida dichotoma, Asclepias quadrifolia, Bidens bipinnata, Brickellia eupatorioides, Centaurea maculosa, Chamaesyce maculata, Chamaesyce nutans, Cyperus filiculmis, Danthonia compressa, Dianthus armeria, Digitaria sanguinalis, Echium vulgare, Euphorbia corollata, Fraxinus americana, Galium pilosum, Hedyotis longifolia, Juniperus virginiana, Kummerowia striata, Linaria vulgaris, Lonicera japonica, Medicago lupulina, Mollugo verticillata, Oxalis corniculata, Parthenocissus quinquefolia, Phytolacca americana, Pinus virginiana, Plantago aristata, Plantago lanceolata, Poa pratensis, Portulaca oleracea, Potentilla recta, Prunus serotina, Quercus alba, Quercus rubra, Rhus glabra, Robinia pseudoacacia, Rosa carolina, Rubus occidentalis, Rubus* subg. *Eubatus* sp., *Rumex acetosella, Scleranthus annuus, Setaria glauca, Senecio antennariifolius, Solidago juncea, Toxicodendron radicans, Trichostema brachiatum, Ulmus rubra, Verbascum thapsus, Veronica officinalis, Viola rafinesquii, Vitis vulpina.*

Bartonia No. 53: 15–16, 1987

The Rediscovery of *Carex decomposita* in Ohio

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One of the recent changes incorporated in the latest Ohio rare plants list (Ohio Division of Natural Areas and Preserves 1986) is the removal of *Carex decomposita* Muhl. from the species presumed extirpated from the Ohio flora. I located this species, commonly known as cypress-knee sedge, on 6 November 1984, while conducting a floristic survey of buttonbush swamp sites at Gahanna Woods State Nature Preserve (Jefferson Township, eastern Franklin County).

The floristic survey included six of the seven buttonbush swamp sites at Gahanna Woods (Tyrrell 1987). I found *C. decomposita* growing throughout the largest (longest dimension of approximately 180 m) of the six sites, but absent from the other five. The site with *C. decomposita* extends beyond the boundaries of Gahanna Woods State Nature Preserve and thus, at present, protection is only afforded to part of this newly discovered population. Based on a re-examination of the area in April 1985, I estimate that at least 200–300 "protected" plants are on the preserve property, and that the entire population totals as many as several thousand clumps of *C. decomposita*.

On 23 April 1985, I visited the seventh swamp site, which was omitted from the original survey, and discovered *C. decomposita* growing there as well! This population, separated from the other by approximately 100 m of moist woodland, consists of more than 300 plants, all within preserve boundaries. Voucher specimens collected on 23 April 1985 from both populations, and collected on 6 November 1984 from the initial discovery site, have been deposited in the herbarium at The Ohio State University.

In Ohio, *C. decomposita* was last obtained in 1910 by Frederica Detmers in Licking County, at Cranberry Island, Buckeye Lake, approximately 30 km east of the extant sites. The other historical records of this sedge in Ohio are from Franklin County ("3 miles west of Columbus"), collected by William S. Sullivant in 1838, and Hamilton County, collected by Thomas G. Lea in 1842.

The *C. decomposita* plants located at Gahanna Woods are growing primarily on buttonbush (*Cephalanthus occidentalis*). In a small survey conducted along a belt transect within one of the Gahanna Woods sites, 90% of the *C. decomposita* plants (99 out of 110) were associated with buttonbush (the remainder were located on fallen logs). Thus, the common name of cypress-knee sedge is not particularly apt in Ohio. The lowest branching point of a buttonbush stem acts as a "platform" for one or several *C. decomposita* plants, elevating the stems above (or near) the highest level of standing water. The sedge roots are thickly matted on the buttonbush "platform," grow downward in a mass sheathing the buttonbush stem, and extend into the muck substrate. The root length between "platform" and soil level for one *Carex* plant examined was approximately 30 cm. The buttonbush swamp is the most suitable habitat in Ohio to search for additional populations of *C. decomposita*. My cursory searches for this species in several other buttonbush swamp sites in central Ohio (Fowler's Woods State Nature Preserve, Richland County; Morris Woods State Nature Preserve, Licking County; Brush Lake, Champaign County; and Pickerington Pond (Columbus-Franklin County Metropolitan Parks), Franklin County) have not met with success.

The entire geographical range of *C. decomposita* historically extended from New York west to Michigan, Illinois, and Missouri, and south to Florida, Louisiana, and Texas (see map in Stuckey 1983), although its current nationwide status is still being investigated and evaluated. Jim Aldrich and Mike Homoya at the Indiana Department of Natural Resources, Division of Nature Preserves, are involved with the overall assessment of the status of this species. *C. decomposita* has been included in the 1985 Notice of Review for consideration for Federal listing as an endangered or threatened species (U.S.D.I. 1985). The rangewide data file on *C. decomposita* as of October 1, 1986, obtained through the courtesy of Larry Morse at the national office of The Nature Conservancy, indicates that the status of this species differs among states. Its status ranges from SH (historical records only) and S1 (1–5 sites) to S4 (more than 100 sites). According to Charles Bryson, Ken Gordon, Steve Orzell, and Ken Smith, in southern coastal plain states, potential habitat for *C. decomposita* occurs widely. They claim that the number of known extant sites in this region is probably substantially less than the actual number because this species has been undercollected due to snake hazards and generally poor accessibility to suitable cypress swamp habitat.

The discovery of *C. decomposita* at Gahanna Woods State Nature Preserve has changed its status in Ohio from presumed extirpated to endangered. Rangewide, the two new populations substantially increase the total number of known plants near the limits of its range, adding at least 500 plants at protected sites. Because so few extant sites are known in the upper midwest, full protection of the entire *C. decomposita* population at the largest swamp site is highly recommended.

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Bartonia No. 53: 17–23, 1987

Notes on Some of New Jersey's Adventive Flora

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In recent years insufficient study has been given to New Jersey's synanthropic flora. Consequently, a number of species have gone unreported or are only imperfectly known. This paper reports on 15 species which have been introduced, either accidentally or deliberately, into New Jersey from Eurasia or from other regions of the U.S. A search of the literature indicated that only one of these species (no. 15) had been reported for the state in the early catalogs and floras of Britton (1889), Stone (1911), and Taylor (1915), while seven of them (nos. 1, 3, 4, 7, 8, 12, 15) were included in recent compilations of the state's flora (Anderson 1979; Hough 1983). Most species discussed below are rather innocuous and probably pose no substantial threats to our native species, but a few, especially nos. 4, 6, 14, and 15, bear close watching as they are aggressive, rapid colonizers.

Specimens have been examined at Chrysler Herbarium, Rutgers University (CHRB), the New York Botanical Garden (NY), the Academy of Natural Sciences of Philadelphia (PH), and my own personal collection. Duplicates for some specimens I collected will be deposited at the above institutions. Complete citations for specimens examined are included except for specimens clearly identified as having been collected from cultivation. A few sight records have been included and are mostly from Abraitys (1957–1983). General range comments have been synthesized from Fernald (1950), Gleason (1952), Gleason and Cronquist (1963) and have been augmented with data derived from herbarium specimens, literature, and conversations with the botanists of some state Natural Heritage Programs and other colleagues. Nomenclature follows Kartesz and Kartesz (1980).

1. **Bassia hyssopifolia** (Pallas) Kuntze

CAPE MAY CO.: waste ground and in thickets on sand dunes, just S of Sunset Beach, Cape May Point, 1 Oct 1986, *D. B. Snyder*. SUSSEX CO.: Along railroad, Limecrest, 16 Sep 1973, *V. Abraitys*, CHRB.

The European *Bassia hirsuta* (L.) Aschers. is of frequent occurrence in wet sands and salt marsh borders throughout NJ's coastal strip. Recently, a second species, *Bassia hyssopifolia*, has been discovered in the state. In the U.S., this Eurasian species is reported in the Northeast from MA south to NY. The earliest NJ record that I'm aware of is a Cape May County sight record by Abraitys: abundant on dry sands around Cape May Point, 24 Sep 1965. It was still frequent at this site in 1986. Abraitys' field notes also lists a third NJ location in Bergen County: Hackensack River marshes at Moonachie. Whether this species will become as abundant in the state as *B. hirsuta*, remains to be seen.

2. **Spergula morisonii** Boreau

BURLINGTON CO.: Common along roadsides, Whites Bog, 16 Apr 1980, *D. B. Snyder*, CHRB; sandy roadside, Whites Bog, 22 Apr 1981, *D. B. Snyder 934*. CAPE MAY CO.: Cold Spring, 12 Jun 1917, *O. H. Brown*, PH; Cold Spring Cemetary, Cold Spring, 16 May 1918, *O. H. Brown*, PH; Brick Church Cemetary, Cold Spring, 28 May 1918, *O. H. Brown*, PH; Cold Spring, 16 Apr 1922, *O. H. Brown*, PH; sandy roadside N of Cape May City, 12 May 1923, *O. H. Brown*, CHRB; gravelly soil, Cold Spring, 10 Apr 1926, *O. H. Brown*, CHRB; Cape May Point, 12 May 1940, *J. T. Curtis*, PH; Cold Spring Cemetary, Cold Spring, 8 Apr 1942, *O. H. Brown*, NY, PH. OCEAN CO.: In ballast along railroad tracks at Lakehurst, 30 Apr 1965, *G. L. Smith, 2377*, NY; sand barrens, Rt. 428 E of Archers Corner, 5 May 1975, *E. A. Laport*, CHRB; local in open sandy wash area by parking lot in Colliers Mills Wildlife Management Area, Colliers Mills, 25 Apr 1981, *W. T. Rankin*, CHRB; sandy roadside, Harry Wright Lake, 20 Apr 1982, *D. B. Snyder 934-2*.[1]

Based on specimens collected by O. H. Brown in 1942 from the Cold Spring Cemetary in Cape May County, NJ, Fernald (1944) reported the first U.S. record for the European *Spergula pentandra*. At CHRB and PH there are a number of specimens collected earlier by Brown from this locality, the earliest being a 1917 specimen identified by Brown as "*Spergula* sp." with a note by B. Long "*Spergula pentandra?*" These NJ collections are the basis for the inclusion of *S. pentandra* in Fernald (1950) and Gleason (1952). The only other *Spergula* listed in these manuals is another European introduction, *S. arvensis* L., which differs from *S. pentandra* in its channelled leaves and non-compressed, narrowly winged seeds.

In the years following Brown's Cape May collections, a number of additional collections have been made from NJ's Coastal Plain of a *Spurgula* which have been identified as *S. pentandra*. G. L. Smith (1966) reported collecting a *Spergula* from Lakehurst, NJ, which he initially identified as *S. pentandra*. It was later determined by Arthur Cronquist to be the very similar European species, *S. morisonii*. Suspecting that some other NJ collections of *S. pentandra* might have been misidentified, I reexamined specimens I had collected and also those at GH, CHRB, and PH. With one exception (see note under *S. pentandra*), all specimens examined proved to be *S. morisonii*. It's interesting to note that two specimens at PH, the 1922 O. H. Brown collection and the 1940 J. T. Curtis collection, were correctly identified as *S. morisonii*. As an aid to prevent future confusion of these species in the state, the following excerpt from J. A. Rattler's (1964) key to the European plants is reprinted below:

Seed wider than its brownish wing; petals ovate, obtuse, contiguous .... *S. morisonii*
Seed as wide as its transparent, shining wing; petals lanceolate, acute not contiguous .... *S. pentandra*

3. **Spergula pentandra** L.

CAPE MAY CO.: Cold Spring, 16 Apr 1975 & 27 Apr 1977, *V. Abraitys*, CHRB, NY.

The large, transparent shining wings of the fully mature fruit of Abraitys' specimens clearly identifies them as *S. pentandra*. A few seeds and flowers from these specimens were sent to Arthur Cronquist who concurred with their identification. The location on the specimens is given as "Cold Spring" but in his notes, Abraitys more precisely identifies the locality as "Cold Spring Cemetary," the same cemetary from which *S. pentandra* was erroneously reported some forty years prior (see notes under *S. morisonii*). Notwithstanding the earlier reports, *S. pentandra* can now be conclusively added to the list of NJ's adventive flora.

4. **Ranunculus ficaria** L.

BURLINGTON CO.: Adventive in dooryard, Moorestown, 6 Apr 1932, *J. Stokes*, CHRB, PH. CAMDEN CO.: Ballast, Kaighns Point, 23 Apr 1898, *C. F. Saunders*, PH. HUNTERDON CO.: Alluvial woods, 1.5 mi SW of Sergeantsville, 13 Apr 1982, *D. B. Snyder 406-2*. MIDDLESEX CO.: South bank of Raritan River, 1–2 km N of New Brunswick, 10 May 1958, *G. Van Alstine*, CHRB; Muddy soil at edge of Raritan Canal,

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[1] In the Gray Herbarium at Harvard University there is a duplicate of the O. H. Brown collection from the Cold Spring Cemetery on 8 Apr 1942. There is also the following additional specimen: Ocean Co.: along RR tracks in Lakehurst, 4 May 1971, G. L. Smith.

1.61 km outside of New Brunswick, 26 Apr 1960, *E. Vandenberg*, CHRB. SOMERSET CO.: J. L. Wells' woods, Easton Turnpike W of New Brunswick, 24 Apr 1941, *L. A. Hausman*, CHRB; Alluvial woods, Vliettown, 15 Apr 1982, *D. B. Snyder 406-3;* Alluvial woods, North Branch 22 Apr 1982, *D. B. Snyder 406-4*. UNION CO.: In moist woodland, Summit, 5 May 1978, *H. N. Moldenke*, NY; naturalized in thickets, Westfield, 3 Apr 1977, *H. N. Moldenke*, NY. WARREN CO.: Moist roadside bank 1.5 mi S of Glovers Pond, 30 Apr 1979, *D. B. Snyder 406*.

Reported as "casually escaped from cult." (Gleason and Cronquist 1963) and "occasionally spreading . . . and locally estab." (Fernald 1950), this species has already become a serious pest in some areas of NJ and can be expected to continue to spread. Introduced from Europe, it is aggressive and spreads rapidly once established. It is naturalized along the Raritan River and some of its tributaries where it occurs from Vliettown along the Lamington River southeast to New Brunswick. Abraitys lists several Hunterdon County locations and also reported it as a widespread escape in Salem County. Where I saw the species along Jacobs Creek in Mercer County, it formed a near solid ground cover.

5. **Akebia quinata** (Houtt.) DCNE.

SOMERSET CO.: Vine on ground and shrubs in open woods, Moggy Hollow, Far Hills, 8 Nov 1981, *D. B. Snyder*, CHRB; abundant in open woods and covering an area of ca one half acre, Moggy Hollow, Far Hills 25 Oct 1986, *D. B. Snyder*. WARREN CO.: Climbing on shrubs along trail, 1 mi W of Sunfish Pond, 15 Aug 1982, *D. B. Snyder*.

This species, which has been introduced from eastern Asia, occasionally escapes and persists after cultivation. At NY and PH I have seen eastern U.S. collections from MA south to NC. The earliest NJ record that I'm aware of is a Warren County sight record by Abraitys: NW slope of Kittatinny Mt. near entrance to Worthington tract, about 1958. Nearly 25 years later, I found the species to be locally frequent at this locality. At both this site and the Somerset County location, *Akebia* is growing at or near long since vanished estates.

6. **Pueraria lobata** (Willd.) Ohwi

MIDDLESEX COUNTY.: Near road opposite Monroe High School on Perrineville Rd, 2 mi S of Jamesburg, 25 Jun 1979, *A. Brueck*, CHRB; railroad embankment, Dunellen, 14 Oct 1982, *D. B. Snyder 1087*, CHRB (discovered by J. Medallis). MONMOUTH CO.: Forming an extensive, solid ground cover at abandoned Air Force Base, 1.2 mi SSE of Highlands, 23 Nov 1986 (first observed here ca 1977), *D. B. Snyder 1087-2*.

This Asian introduction, which is wreaking ecological and economical havoc throughout much of the southeastern U.S., is aggressively expanding its range. Fernald (1950) reports it north to PA and TN but it is now known to occur north to OH (Allison Cusick pers. comm), CT, MA (Bruce Sorrie pers. comm.), and perhaps elsewhere. In NJ it was reported from Cape May County in 1968 by Abraitys: empty lot in Cape May near railroad, climbing to top of phone pole. In 1986 I revisited the two locations where I collected it. In Dunellen, where it's climbing over shrubs, trees, and an old factory, it has not spread appreciably. While after nearly ten years, it has only made modest gains at the Air Force Base in Monmouth County. Still, this species bears careful watching in the state.

7. **Rhus aromatica** Ait.

Var. **arenaria** (Greene) Fern.: BURLINGTON CO.: abundant in dry, sandy thicket on Rt 9 overpass ca 1 mi S of New Gretna, 14 Sep 1986, *J. Arsenault & D. B. Snyder*. MORRIS CO.: 1 plant in weedy thicket at edge of Howard Johnson's parking lot, ca 2 mi NW of Denville, 6 Sep 1986, *D. B. Snyder*.

Var. **aromatica**: MIDDLESEX CO.: Growing in sandy shale in overgrown field, 4.0 km NNW of New Brunswick, Piscataway Twp, 9 May 1961, *R. Wells*, CHRB.

Rhus aromatica occurs natively in a few states in the northeastern U.S. (Dowhan 1979; Fernald 1950; Mitchell 1986; Wherry et al. 1979), but it is more typical of the midwestern and southern states. In NJ its possible that native occurrences may yet be discovered, but the known records all seem to be adventive. It certainly is not native at the Morris County location. The Burlington County site, which was discovered by Abraitys in 1975, is puzzling, but is presumably also adventive. The circumstance of the Middlesex County site is not known, but its occurrence on or near the campus of Rutgers University suggests it is adventive there.

8. **Hydrocotyle sibthorpioides** Lam.

BURLINGTON CO.: Small patch on roots of uprooted tree within the upper tidal limits of the Delaware River, Edgewater Park, 23 Oct 1986, *D. B. Snyder*.

Introduced from tropical Asia, this tiny umbellifer is reported as established in lawns in OH (Allison Cusick pers. comm.) PA, VA, DC, and IN. The species has been also collected in similar situations in NJ (ESSEX Co.: Upsala College, Prospect St and Springfield Ave, East Orange, 28 Oct 1948, *R. L. Schaeffer, Jr. 30909*, PH, MERCER CO.: in patches along curb on Richey Place off State St, Trenton, 8 Oct 1968, *V. Abraitys*). The Delaware River shore collection is apparently the first record of a naturalized occurrence in the state.

9. **Cynanchum nigrum** (L.) Pers.

ATLANTIC CO.: At edge of woods near Rt. 30 (White Horse Pike), Elwood near Wharton Park, 29 May 1985 and also 2 Aug 1986, *R. L. Benner 569A & B*, CHRB. BERGEN CO.: Locally frequent at summit of the Palisade escarpment, Alpine, 23 Aug 1981, *T. Halliwell & D. B. Snyder 1036;* [county not specified] Passaic River, Jul 1924, *J. A. Allis*, NY. WARREN CO.: Climbing on guardrail between RR and road, ca 1 mi N of Phillipsburg, 7 Sep 1986, *D. B. Snyder 1036-2*.

There is a very old Essex County specimen at NY collected in cultivation: Bower's garden, Newark, 31 Jul 1868, *W. H. Leggett*. The species is native to Europe.

10. **Elsholtzia ciliata** (Thunb.) Hyl.

MORRIS CO.: Abundant at edge of wooded thicket between road and small stream, ca 0.5 mi S of Morris Plains, 25 Oct 1986, *D. B. Snyder* (discovered by L. J. Mehrhoff ca 1981).

This distinctive, late flowering mint has been introduced from Asia into the eastern U.S. where it is spreading. Fernald (1950) reports it from Quebec to ME, while Gleason and Cronquist (1963) extend it south to NY. I have seen specimens from the following additional states: PA (CHRB PH), WV (NY), and NC (CHRB NY).

11. **Viburnum dilatatum** Thunb.

MONMOUTH CO.: A few shrubs near base of moist wooded slope, ca 0.9 mi SW of Highlands, 18 May 1986, *D. B. Snyder;* several shrubs in thicket at edge of woods along old fence row, 14 Sep 1986, *D. B. Snyder*.

While exploring Coastal Plain woods near Sandy Hook in May, 1986, I found a species of *Viburnum* that did not readily key to any species described in Fernald (1950), Gleason (1952), or Gleason and Cronquist (1963). In the fall, specimens with mature fruit were obtained at a second site, not far from the first, and it was apparent that the species was not any of those described in the above manuals. Through Bailey (1949) the species was identified as *Viburnum dilatatum,* native to eastern Asia. The species can be recognized by its scaley winter-buds; unlobed rotund to broadly obovate toothed leaves, hairy on both surfaces; peduncled cymes; and bright red fruit with compressed stones. Although long in cultivation in the U.S. (Rehder 1927) the species apparently has been only recently reported as an escape in the northeastern U.S. I have seen collections from PA (BUCKS CO.: Chalfont, Forest Park, 4 Sep 1986, *A. E. Schuyler 6726*, PH; MONTGOMERY CO.: Wyncote, 29 May 1951, *B. Long 73154*, PH) and it is reported for NY (Mitchell 1986).

12. **Ambrosia bidentata** Michx.

MIDDLESEX CO.: 0.5 mi NE of the intersection of Metlars Lane and Davidson Road on the Livingston Campus of Rutgers University, 1 Sep 1970, *J. Hanks*, CHRB, NY, PH; frequent along trail through old field, Kilmer Woods, ca 0.8 mi NW of Highland Park, 9 Nov 1986, *D. B. Snyder*.

Ambrosia bidentata is native to North America where it occurs from MN south to TX and east to OH and NY (Mitchell 1986). The species has been introduced into a few states along the eastern seaboard (Fernald 1950; Gleason and Cronquist 1963; Dowhan 1979). In NJ it occurs very locally in the vicinity of New Brunswick where it has become naturalized. At the location I observed in 1986, it occurred abundantly along trails scattered through a series of old fields. Although now owned and maintained as an ecological reserve by Rutgers University, these fields were formerly part of the Camp Kilmer Military Reserve.

13. **Aster tataricus** L.f.

GLOUCESTER CO.: Path through woods along tributary to Coopers Creek, NE of Haddonfield, 10 Oct 1934, *J. M. Fogg, Jr., 7627*, PH; escaped (persistent?) near old cellar hole along Fries Mill Road, about 3 mi NE of Clayton, Oct 1975, *W. R. Ferren, Jr.*, PH. BURLINGTON CO.: Dense colonies of several hundred plants in clearing in sandy pine/oak woods with *Syringa vulgaris* L., *Artemisia ludoviciana* Nutt., etc., S side of Smithville Lake, Smithville, 27 Sep 1986 and 11 Oct 1986, *D. B. Snyder*.

I doubt whether the Asian *Aster tataricus* is fully naturalized in the state. Rather, like *Akebia quinata* discussed previously, the species apparently persists long after cultivation and may even spread locally.

14. **Carlina vulgaris** L.

MORRIS CO.: About 30 plants at edge of old field, Black River Wildlife Management Area, ca 1 mi NE of Pleasant Hill, 25 Oct 1986, *D. B. Snyder* (discovered by T. Halliwell). SUSSEX CO.: About 50 plants in old field along Rt 94, 0.3 mi N of Yellow Frame, 5 Oct 1986, *D. B. Snyder*. WARREN CO.: 300–400 plants on steep, grassy road embankment at Exit 19 of I-80, just SSE of Allamuchy, 12 Oct 1986, *D. B. Snyder*; frequent in somewhat overgrown field, Allamuchy State Park Natural Area, 0.7 mi NNW of Hackettstown, 12 Oct 1986, *D. B. Snyder* (discovered by T. Halliwell ca 1982).

While searching for unusual *Cirsium* species along the back roads of Sussex County, I spotted a thistle which was new to me. It superficially resembled a species of *Cirsium* or *Carduus* but differed from these genera in its elongate and reflexed stramineous involucral bracts and strigose achenes. I identified it as the Eurasian *Carlina vulgaris*, which while described in Fernald (1950), Gleason (1952), and Gleason and Cronquist (1963), is not included in their keys to the genera. Subsequently, Tom Halliwell, informed me of an odd thistle he had found at two locations which fit the description of *Carlina vulgaris*. The plants at both of his locations did prove to be *Carlina* and a fourth station for *Carlina* was discovered while enroute to voucher one of the Halliwell sites. Presumably the species has only very recently become established in the state since it seems unlikely that such a conspicuous plant could remain undetected for very long in a state so well botanized as NJ.

Clausen (1949) reported the first U.S. occurrence of *Carlina vulgaris* in 1944 from Cortland and Tompkins counties in west central NY. Richard Mitchell (pers. comm.) reports that it has spread from this locality and now occurs as a weed around Ithaca. The nearest NJ population is about 125 miles to the southeast. The only U.S. specimens I have found in herbaria are those collected by Clausen (NY). The species is not reported for PA (Wherry et al. 1979) and its occurrence in OH (Allison Cusick pers. comm.) or New England (Bruce Sorrie and Tom Rawinski pers. comm.) could not be confirmed. The species is likely to continue to spread in the Northeast.

15. **Liatris pycnostachia** Michx.

ATLANTIC CO.: Egg Harbor City, 23 Jul 1975, *V. Abraitys*, CHRB; (forma *hubrichti* E. Anderson) frequent with the typical color form in field along RR, Devonshire, ca 1.2 mi NW of Egg Harbor City, 2 Aug 1986, *F. Brackley, D. Mehlman, D. B. Snyder 1281-4*. BERGEN CO.: Moonachie, 21 Aug [no year specified], *G. V. Nash*, NY; Moonachie, 21 Aug 1915, *P. Wilson*, NY. BURLINGTON CO.: Roadside along Rt 206 N of Red Lion, 13 Aug 1978, *D. B. Snyder 1281*. MIDDLESEX CO.: escaped or adventive along sandy roadside ca 1 mi N of Helmetta Pond, 20 Aug 1983, *D. B. Snyder 1281-3*, CHRB.

This species is indigenous to the prairies of the midwest and ranges east to IN and KY. The NJ records are all presumed to be escapes from cultivation. The species is fully naturalized in sandy fields and along roadsides near Egg Harbor City. Abraitys writes of his 1975 collection ''running rampant near a small farm on the southeast side of Egg Harbor City, probably an escape from an old commercial planting.'' The species has subsequently been found along a number of roads in the vicinity of Abraitys' collection site. The Devonshire occurrence, which is extensive, occurs about two miles to the northwest of Abraitys original site. The species is also reported as an escape in NY (Mitchell 1986) and OH (Allison Cusick pers. comm.).

ACKNOWLEDGMENTS

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Bartonia No. 53: 24–33, 1987

Rafinesque's Specimens in the Darlington Herbarium of West Chester University

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The lack of existing botanical specimens from C. S. Rafinesque's herbarium to support his many botanical writings has been of concern to botanists for many years. Francis Pennell (1942) in "The Life and Work of Rafinesque" was aware of Rafinesque's specimens in the Darlington Herbarium at West Chester University as indicated by a short footnote. But neither he nor other botanists (Gordon 1943; Merrill 1949; Stuckey 1971a) appear to have been aware of the size of the collection.

Elias Durand, curator of the herbarium at the Academy of Natural Sciences of Philadelphia, purchased Rafinesque's herbarium in 1841 (Stuckey 1971b). Rafinesque had died in poverty in Philadelphia in 1840. Durand sent Dr. William Darlington of West Chester, Pennsylvania, 1500 specimens in 1841 including material from Rafinesque (Gordon 1943). Nearly all of the 299 Rafinesque specimens with Rafinesque's handwriting on the labels give "E. Durand" as the source (Fig. 1). Four specimens with Rafinesque's handwritings on the labels do not have Durand's name on them. In comparing these specimens to known Durand source material, including the paper type of the original labels and with handwriting other than Rafinesque's, there appears to be little question that they also came from Durand.

Much of the Rafinesque material sent by Durand to Dr. Darlington for the Chester County Cabinet of Natural Science herbarium (now the Darlington Herbarium), was from foreign countries. Rafinesque was noted among contemporary botanists for his poor specimens (Pennell 1942; Merrill 1949) so it appears that only difficult-to-obtain or rare specimen were selected by Durand. It is probable that Darlington requested only such material as he did not trust Rafinesque as a botanist. This suggestion is indicated by marginal notes on Rafinesque's publications in Darlington's library, which is in the special collections of West Chester University, and by notes on specimen labels in Rafinesque's herbarium (see number 300).

Forty specimens have Rafinesque's printed label "Autikon Botanikon" with his handwritten notes on the labels (Fig. 1). Two specimens, nos. 2 and 16, are not in the published *Autikon* even though they have *Autikon* labels. Charles Boewe, a Rafinesque scholar, has suggested that they may have been from the proposed parts 4 and 5 of the *Autikon* that were never published. He also noted that the dates 1816–1836 on the labels indicate they were printed in advance of the book, the first part of which was issued in October 1839.

In 1981 Diane Rofini, a graduate student at West Chester University, under a supported graduate student research study program, reviewed all of the 1000-plus Elias Durand specimens in the Darlington herbarium for possible Rafinesque handwriting on

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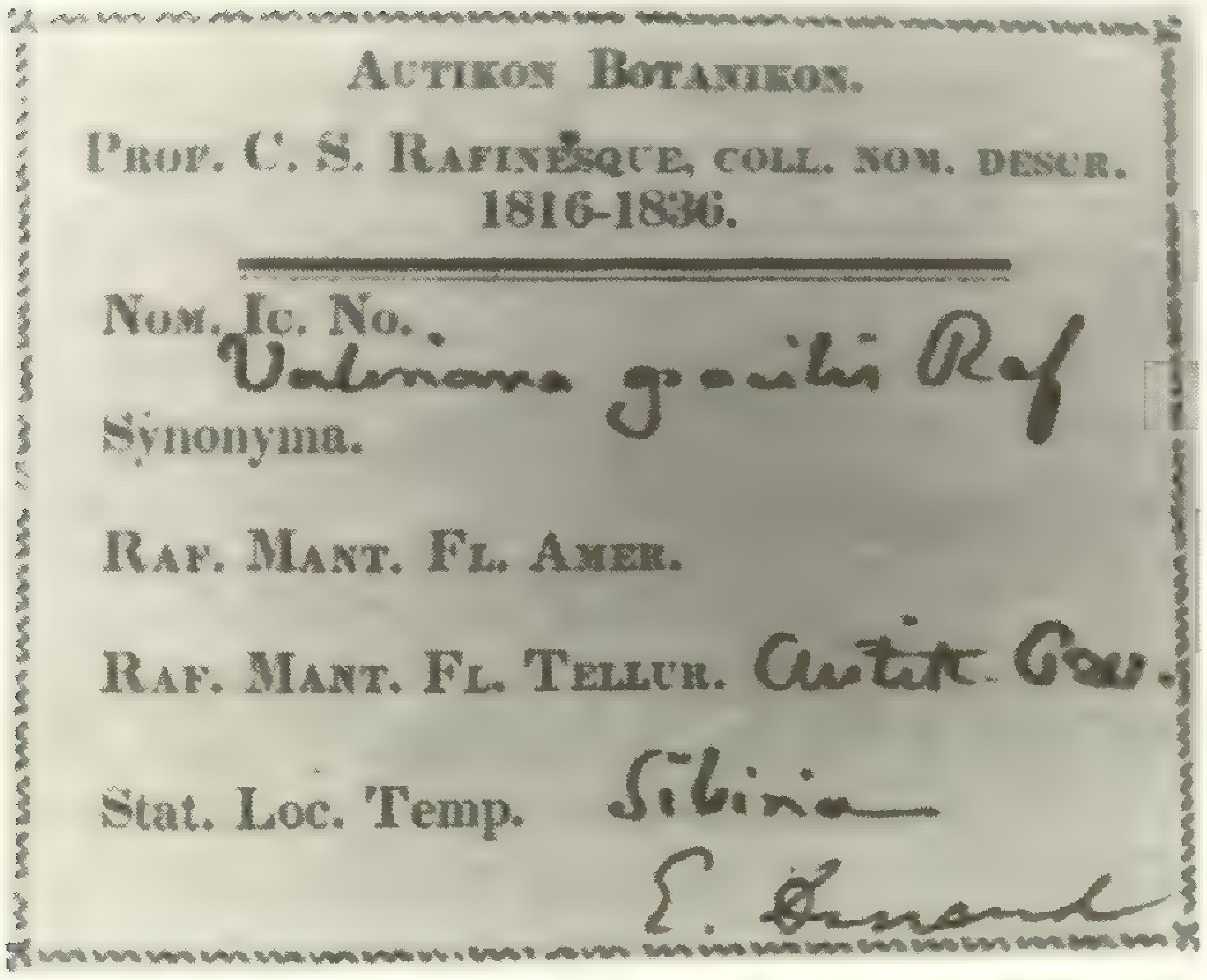

AUTIKON BOTANIKON.
PROF. C. S. RAFINESQUE, COLL. NOM. DESCR.
1816-1836.

Nom. Ic. No. Valeriana gracilis Raf
Synonyma.
Raf. Mant. Fl. Amer.
Raf. Mant. Fl. Tellur. Autik. Bot.
Stat. Loc. Temp. Sibiria
E. Durand

FIG. 1. Label from an *Autikon Botanikon* specimen in the Darlington Herbarium.

the labels. From over 250 specimens selected by Rofini and about 150 additional specimens which had previously been segregated from the general collection, the present list was compiled. Most of the Rafinesque labels, 271 out of 303, have been observed and confirmed by Joseph Ewan, James Mears, and Ronald L. Stuckey when they were participants in the Dr. William Darlington bicentennial observance program at West Chester University in April 1982. More recent additional material added by the senior author has been carefully compared to the confirmed reference collection.

Rafinesque's handwriting does not appear on 24 of the labels. Of these, eight specimens have "from Raf" or "Rafinesque Herbarium" written on the labels. Sixteen specimens have the word "Raf" or "Rafin" added on the corner of the label (not part of the binomial). All were from Elias Durand and without doubt came from Rafinesque's herbarium. For several specimens, we refer to quotations in *Autikon Botanikon* (see nos. 42, 142, 144, 145). The locality, collector, and label on these specimens appear to refer to the original specimen Rafinesque cites accompanying his description in the *Autikon*. None of these specimens has a printed *Autikon* label. Notes on cited published sources of Rafinesque unavailable to the authors and on selected problems of synonomy are based on E. D. Merrill's very helpful *Index Rafinesquianus* (1949).

LIST OF RAFINESQUE'S SPECIMENS IN THE DARLINGTON HERBARIUM

The list of specimens is divided into four parts. Within each part, names are arranged alphabetically by family, and alphabetically by genus within each family. The individual specimen listings contain (1) a serial number for reference, (2) the number of the taxon in the published *Autikon Botanikon* except where noted otherwise, (3) the name of the taxon on the label, and (4) notes in quotes from the labels, often with additional comments by us. All but four specimens in Parts I, II, III, and IV have the name Durand written on the label. Those without the Durand designation appear to be also from Durand when compared to the other labels and related collections. We thank Joseph Ewan, Ronald L. Stuckey, and James Mears for help in confirming specimens with Rafinesque's handwriting on the labels and Charles Boewe for his critical review of the list.

PART I. Labeled specimens from the *Autikon Botanikon* (1815–1840) with original printed labels (Fig. 1).

ACANTHACEAE
1. 367—*Aldina glechomoides*—"Cuba"

COVOLVULACEAE
2. N. Fl. N. Am. 875—Ipomea humilis—"Raf. Mant. Fl. Amer. 875"

DIPSACACEAE
3. 630—*Astrocephalus pumilis*—"Mt. Etna"
4. 628—*Succisa bidentata*—"Hispania"
5. 626—*Succisa integrifolia*—"Helvetia"
6. 629—*Succisa lancifolia*—"Styria"

EUPHORBIACEAE

7. 681—*Dematra sericea*—"Palestina" Type, designated by Louis C. Wheeler 1942
8. 657—*Keraselma pungens*—"Palestina"
9. 652—*Keraselma retusa*—"Hisp. Galli"
10. 664—*Kobiosis mellifera*—"Madera"
11. 365—*Merleta microphyla*—"Cuba"
12. 633—*Tithymalis cinerea*—"Styria" Type, designated by Louis C. Wheeler 1942
13. 650—*Tithymalis connata*—"Syria"
14. 366—*Vandera discolor*—Type, designated by Louis C. Wheeler 1942
15. 699—*Xamesike rotundifolia*—"Central America" Type, designated by Louis C. Wheeler 1942

GRAMINEAE

16. N. Fl. N. Am. 917—*Jalambica pumila*—"Fl. and Cuba" "Raf. Mant. Fl. Amer. 917"

LABIATAE

17. 865—*Amaracus dictamnus*—"Creta" (Merrill does not list the epithet)
18. 847—*Leonurus reticulatus*—"Mts Allegh" Mts. Alleghanies
19. 870—*Nepeta levigata*—"Illyria"
20. 849—*Panzeria villosa*—"Sibiria"

LAURACEAE

21. 575—*Camphora vera*—"Borneo"

LILIACEAE

22. 946—*Aniketon coriaceum*—"Cuba" (found by Jalambic)
23. 990 = 996—*Atevala imbricata*—"Africa"
24. 997—*Atevala remotiflora*—"Africa"
25. 487—*Codomale purpurascens*—"Sibiria"
26. 924—*Danae racemosus*—"Grecia" (not in Merrill)
27. 913—*Hyacinthus orientalis*—"Persia" (epithet not in Merrill)
28. 914—*Lagocodes nutans*—"Belgio, Anglia"

MAGNOLIACEAE

29. 588—*Illicium reticulatum*—"Florida" Found by Kin

POLYGONACEAE

30. 921—*Rayania* 5 nervia quinque nervia [text has "*Rayania quinquenervia*"]—"Cuba"

SCROPHULARIACEAE

31. 774—*Verbascum claytoni*—"Carol." (epithet not in Merrill)

SOLANACEAE

32. 765—*Antimion peruvianum* (label) (*Antimion tomentosum* of Autikon Botanikon p. 109)—"Peru" "sent to me as *S. peruv.*" Aut. Bot.
33. 792—*Blencoes glutinosa*—"Peru"
34. 790—*Hyosciamus physalodes*—"Sibiria"
35. 766—*Scubulon incanum*—"Peru"

URTICACEAE

36. 385—*Parietaria rufa*—(discovered by Bradbury)

VALERIANACEAE

37. 612—*Kentranthus ruber*—"As, Afr Eur" (Asia, Africa, Europa)
38. 613—*Rittera calcitrapa*—"Europea"
39. 601—*Saliunca plantaginea*—"Caucasus Mts"
40. 620—*Valeriana gracilis*—"Sibiria"

PART II. Specimens thought to be from Rafinesque's herbarium that were given to William Darlington by Elias Durand. The labels have confirmed handwriting of Rafinesque.

ACANTHACEAE

41. 342—*Dianthera formosa*—"S Ameri"
42. 250—*Idanthisa ligustrina*—"India?" Label "Autik 250"; label with *Just. superba* not in Raf. hand, See Aut. Bot. p. 31
43. 251—*Rodatia reticulata*—"NG 251 Aut E. Indies S. Amer"

Aizoaceae

44. 35—*Glinus lotoides* Houtluyn.—"Egypt"

Alismataceae

45. 454—*Luronium natans*—"Canada"

Amaranthaceae

46. 1137—*Steiremis heterophyla* (*Achyranthis axillaris*) (text lists *Steiremis heterophyla*, remarking that plant is *not Achyranthis axillaris*), both names on label in Raf. hand, *Achyranthis* above and *Steiremis* added below—"Egypt"

47. 1101—*Aerua tomentosa*—"Desert of Arab"

48. 1112—*Celosia cordata*—"India"

49. 1114—*Gomphrena ciliata*

50. 1115—*Gomphrena lanceolata*—"Brazil" includes separate label with *Gomphrena brasiliensis*, all appear from same collection, mounted together on one herbarium sheet

51. 1102—*Nevrola fuscata*—"Asiatica" "N. G." 9 line Latin description by Raf.

Amaryllidaceae

52. *Crinum ceruleum ludovicianum*—At. Jour. p. 164, 10 line label in Latin, Raf. hand

Anonaceae

53. "Cherimoya of Peru"—Anal. Nat. p. 175: "*Cherimolia*"

Araceae

54. 1486—*Amidena undulata*—"Sib. diff *A. japonica*"

55. Fl. Tellur. 821—*Podospadix reticulata*—"Fl. Tel 821" Fl. Tellur. 4: 14

56. *Spathyema cordata*—"Africa" Epithet not in Merrill, Genus but not this species in Fl. Tellur.

Asclepiadaceae

57. 1327—*Asclepias fruticosa*—Aut. Bot. 1327: "*Gomphocarpus fruticosus*"

58. 1350—*Cynanchum microphylum*—"882 N Fl." "Florida"

Begoniaceae

59. *Begonia asgyrotelis*—"Brazil" CSR: *Trilomisa*, Fl. Tellur. 2: 91 (epithet not in Merrill)

Berberidaceae

60. *Berberis pisifera*—"Mts Unaka" "379 New Sylva" Sylva Tellur. p. 68

Betulaceae

61. *Carpinus orientalis* Mill.—"Armenia"

62. *Corylus avellana?* Thunb.—"Cult. Pens"

Boraginaceae

63. N. G. near *Echium*—"Iberia"

64. *Heliotropium microphyllus* (*microphyllum*) Sw. ex Wikstr.—"Egypt"

Calycanthaceae

65. *Chimonanthus parviflorus*—"N. G. Japan" Alsogr. Am. p. 6

Caprifoliaceae

66. *Sambucus racemosus* (*racemosa*) L.

67. *Viburnum obliquatum*—"Siberia" Alsogr. Am. p. 54

Caryophyllaceae

68. *Dianthus arboreus* L.—"Creta"

69. 137—"*Dianthus* 3 punct" (*tripunctatus*) Sibth. & Sm.—"G. Creta"

70. 223—"*Tunica*" dianthoides, *Gypsophila dianthoides*

71. 216—*Gypsophila nudic* (*nudicaulis*)

72. 224—*Gypsophila podolica*—"*Podolia*" 10 line label description in Latin in Raf. hand. "*Tunica*" written above *Gypsophila* by Raf., *Tunica podolica* of Aut. Bot.

73. 1106—*Herniaria laxa*—"Detailed label, "N. Sp." 7 line latin description by Raf.

74. 211—*Ixoca tenella*—also "Alps de Baviere" not Raf. hand

75. 1135—*Lahayea fragilis*—Printed label "Pyranides gyzenses," see Aut. Bot. p. 154

76. *Lychnis grandifl* (*grandiflora*) Jacq.—"China"

77. 1130—*Illecebr lanatum* (*Illecebrum*)—"Siberia"

78. *Melandrium capitat*—Not in Merrill

79. 1289—*Minuartia dichotoma* Echeand.—"Hisp."

80. *Silene picta* Pers.—"Italia"

CHENOPODIACEAE

81. *Asthramnium salicamoides*—"N. G." (not in Merrill)
82. *Beta maritima* L.—"Egypt"
83. *Suaeda baccata* Forsk.—"Egypt"

COMPOSITAE

84. 73—*Alcina perfoliata* Cav.
85. *Artemisia austriaca* Jacq.
86. *Atractylis* L. (probably, some letters not clear)
87. *Centaurea austriaca*
88. *Centaurea procurrens* Sieber, ex Spreng.—"Palestina"
89. *Conyza candida* L.—"Mt Ida., Creta"
90. *Chrysanthemum petiolaris*—"Mts Apalaches" (epithet not in Merrill)
91. *Cnicus orientalis* Willd.
92. *Discomela cordifolia*—"N 512" (epithet not in Merrill)
93. *Discomela glauca*—"N 515" (epithet not in Merrill)
94. *Discomela gummifer*—"N 514" (epithet not in Merrill)
95. *Discomela longipes*—"532" "Mts Wasioto" (epithet not in Merrill)
96. *Discomela nudicaulis*—"N. 513" (epithet not in Merrill)
97. *Discomela oblongifolia*—"Mts Warish"?? (epithet not in Merrill)
98. *Discomela uniflora*—Epithet not in Merill
99. *Erigeron chinense* (*chinensis*) L.
100. *Eupatorium elegans*—Epithet not in Merrill
101. *Eupatorium pectinatum*—At. Jour. p. 17
102. *Gnaphalium*—"Src" CSR listed 5 species of this L. genus
103. *Gnaphalium angustifolium* Loisel.—"Hisp and Neapot"
104. 64—*Kuhnia elliptica*—"Mts Cumb."
105. *Leontodon palustre* (*palustris*) Sm.—"Labrador"
106. *Prenanthes spinosa* Forsk.—"Palistina"

CONVOLVULACEAE

107. *Ipoma heterophylla*—"Cuba, Florida" (*Ipomoea palmata* added by Darlington) CSR: *Hemilasis*, Fl. Telur. 4: 74

CYPERACEAE

108. *Eriophorum angustif* Roth. (*angustifolium*)—"Mts Catskill"
109. *Scirpus littoralis* Schrad.—"Palestine"

DIPSACACEAE

110. *Dipsacus angustifolius*—"223" 5 line Latin description by Raf. (epithet not in Merrill)
111. N. Fl. N. Am. 215—*Dipsacus cuneifolius*—"Mts Allegh" "423 Nach"

ERICACEAE

112. *Erica mediterranea* L.—"Grecia"
113. *Erica tetralix maritima*—"Belgica" (not in Merrill)
114. *Erica tetralix* L.—"Gallia"

EUPHORBIACEAE

115. *Chamesyce palestina*—"Palestina" CSR: "*Chamysyke*"; epithet not given, New Fl. N. Am. 4: 44

FRANKENIACEAE

116. (*Frankenia hirsuta*) L., printed label, "*Fr villosa*" Raf. hand

GENTIANACEAE

117. *Amarella fasciculata* "*G. amarella* near *fasciculata*" in Raf. hand—"Alpibus" (epithet not in Merrill)
118. *Chlora gracilis*—CSR: "*Chlorita*" or "*Chloryta*," epithet not given
119. *Gentiana Daisistepha*—Epithet not in Merrill

GESNERIACEAE

120. 83—*Didymocarpus crenulatus*—"Australia" (not in Merrill)

GRAMINEAE

121. *Arundo ampelodesmos* Cyrill.—"Palestina"
122. *Cenchrus tribuloides* L.

123. “Grasses from the Western States” (no species stated but appears to be a specimen of *Phalaris*)
124. Eleusine brevispica—“E. Egypt Sicily” (epithet not in Merrill)
125. *Eleusine convoluta*—W. Baldwin label, Montevideo 1818, including Rafinesque added Latin name (epithet not in Merrill)
126. Sitanion elymoides—Herb. Raf. p. 40

Guttiferae

127. *Hypericum dolabriforme*—CSR: *Streptalon saxatile*, F. Tellur. 3:80.
128. *Hypericum empetrifolium* Willd.—“G. Creta”
129. *Hypericum grandiflorum*—“Alaska and Sibi” 7 line label in Latin in Raf. hand, Herb. Raf. p. 50
130. *Hypericum lasistemon*—“Oregon N. Siberia” 5 line Latin label in Raf. hand, Herb. Raf. p. 50
131. *Hypericum laurifolium*—“Florida” “238 Neval” Herb. Raf. p. 79

Iridaceae

132. 905—*Crocus vittatus*

Labiatae

133. 894—*Enipea formosa*
134. *Glechoma parviflora*—“Allegh” “N sp” (epithet not in Merrill)
135. *Glechoma rotundif* (*rotundifolia*)—“Arkansas W. Kenty” CSR: “-folia”; Herb. Raf. p. 23
136. 897—*Glutinaria acuminata*—“Sibiria”
137. 888—*Hemistegia mexicana*—“*Salvia do* L.”
138. N. Fl. N. Am. 768—*Lycopus axillaris*—“N Fl. 765” Additional label not Raf., W. Florida, Major Ware, see N. Fl. p. 19 (epithet not in Merrill)
139. 828—*Lycopus exaltatus*—“Boh.” (Bohemia)
140. 864—(*Origanum*) *syriacum* Majorana—“Majorana”
141. 803—*Mentha citrata*—Epithet not in Merrill
142. 815—*Mentha obliqua*—“Sibiria” has label *Mentha hirsuta* not in Raf. hand, see Aut. Bot. p. 113
143. 871—*Nepeta heliotropea*—Has label *Nepeta graveolens* with line through it, not in Raf. hand; CSR: “heliotropa”; epithet not in Merrill
144. 870—*Nepeta levigata*—“Hispanda” *Nepeta tuberosa* on original label, not Raf., see Aut. Bot. p. 120
145. 877—*Nepeta lupulina*—Has label *Nepeta nepatella*, not Raf., see Aut. Bot. p. 119
146. 875—*Nepeta origanifolia*—“Creta” has original label *Nepeta incana*
147. 855—*Phlomis sanicala*—“Palestina”
148. *Salvia viridis* L.—“Creta”
149. 898—*Sclarea acuta*—“Sibiria?”
150. *Stachys annua* L.
151. *Teucrium pseudohyssopus* Schreb.—“Palistina”
152. 857—*Trambis tuberosa*—Original label not Raf., *Phlomis tuberosa*, see Aut. Bot. p. 118
153. *Trich glauca* (*Trichostema glauca*)—“Mts Alley” (epithet not in Merrill)

Leguminosae

154. *Acacia stephaniana* Willd.—“Palestina” CSR: “Acakia”
155. *Aspalathus plan*—Epithet not in Merrill
156. *Bauhinia? reticulatae* (*reticulata*) DC.
157. 543—*Colutea orientalis* Lam.
158. 550—*Coronilla rosea*—“Persia”
159. *Lotus glaucus* Dryand—“Palestina”
160. *Lupinus syriacus*—“Nsp” 5 line Latin label, Raf. hand (epithet not in Merrill)
161. *Melilotus messanensis* All.—“Sicily”
162. *Ononis campestris* Sieber.—“Palestina”
163. *Orobus niger* L.—“Alps”
164. *Ornithopus monyx*—“Silica” (not in Merrill)
165. *Vicia articulata* Hornem.—“Hispan”
166. 51—*Vicia leptophyla*—“Mts Sicily”

Liliaceae

167. 430—*Aglitheis melopolis*
168. *Bulbine*—Raf (*Anthericum liliago*)—Fl. Tellur. 2:28
169. 491—*Convallaria biflora*—“Gallia” *Sigillaria biflora*, Aut. Bot. p. 68

170. 488—*Convallaria verticillata*—"Europe" *Troxilanthes lanceolata, Troxilanthes ramosa*
171. *Frittilaria paucifolia*—"Sibiria" (epithet not in Merill)
172. *"Funkia latif. cordifolia"*—"Japan" (epithet not in Merrill)
173. 460—*Funckia angustifolia*—"Japan" "Funkia" spelled in Aut Bot.
174. 405—*Gagea fascicularis* Salisb.
175. 999—*(Aloe cymbiforme) Kumaria cymbiformis*—Original label (*Aloe*) not Raf. hand
176. 403—*Loncomelos pyramid* (*pyramidalis*)—"Lustit" (Lusitania)
177. 916—"*Pelotris panicul*" (*paniculatus*)
178. *Phalangium ramosum* Houtt.—"G. Creta"
179. "*Pleisolirion*"—Fl. Tellur. 2: 28, no. 76, *Anthericum liliastrum* on original label, not Raf. hand
180. 401—*Reggeria bohemica*
181. 411—*Skilla filiformis*—"Africa austr"
182. 402—*Syncodium* (*nutans*)—"Fl. Tellur. 2: 22, no. 52, specimen identified as *Ornithogalum nutans* by E. Durand

LOGANIACEAE

183. *"Gelsemium?"* Juss.

MALVACEAE

184. *Kitaibelia vitifol* (*vitifolia*) Willd.—"Hungaria"
185. *Urena mollis* R. Br.—"China" 6 line label in Raf. hand.

MARANTACEAE

186. *Maranta bicolor* Vell.—"Australasia"

MORACEAE

187. 1100(1000)—*Morus cretica*—Aut. Bot. p. 150, no. should be 1100

MYRTACEAE

188. 1075—*Melaleuca granulata*—*Ozanda granulata* of Aut. Bot. Original label: Werner, Darlington hand "New South Wales"

NYCTAGINACEAE

189. 85—*Trimista levigata*—"Guatimala Mexico" 9 line label in Latin in Raf. hand

OLEACEAE

190. *Olea fragran* (*fragrans*) Thunb.—"China and Jap"
191. *Ornanthes mannifera*—"Sicily"

OROBANCHACEAE

192. *Orobanche peduncularis* (*pedunculata*) Viv.—"19 Nevat"

PHYTOLACCACEAE

193. *Phytolacca glauca*—Not in Merrill

PINACEAE

194. *Juniperus barbadensis* Thunb.

PIPERACEAE

195. 99—*Troxirum varians*—"Guatim" Original label not Raf. *Piper verticillatum*, see Aut. Bot. p. 14
196. 98—*Troxirum villosum*—It has "*Piper blandium*" on original label not in Raf. hand, see p. 14 Aut. Bot.

PLANTAGINACEAE

197. *Plantago balduini*—"Mt Video" Rest of label in Baldwin's hand,
198. *Psyllium rufum*—N. Fl. N. Am. 4: 12, not in Merrill

POLEMONIACEAE

199. *Gillia capitata* Sims. (*Gilia*)
200. *Gilia capitata*—"Florida"

POLYGALACEAE

201. *Polygala*—"Ebrglia"

POLYGONACEAE

202. *Acetoda amplexifolia*—"Grecia" (not in Merrill)
203. *Polygonum equisetiforme*—"Palist" CSR: *Dioctis equisetifolia*, Fl. Tellur 3: 15
204. *Polygonum herniaroides* Delile—"Nilus"??
205. *Rayania furcata*—epithet not in Merrill
206. *Rumex venosus* Pursh

POLYPODIACEAE

207. *Polypod*—“Cuba”
208. *Polypodium bullatum*—Herb. Raf. p. 41

PRIMULACEAE

209. *Anagallis phoenicea* Scop.
210. *Samolus diculus*—3 line latin label by Raf. (epithet not in Merrill)

PROTEACEAE

211. 1003—*Hakea pugioniformis* Cav.—Rest of label illegible
212. 1002—*Icmane heteroph* (*heterophylla*)
213. 1009—*Protea pilosa*—“S Africa”
214. 1008—*Protea rugosa*—“S Africa”
215. *Icmane glauca*—“S Africa” “Australia” 7 line label in Latin in Raf. hand (epithet not in Merrill)

RANUNCULACEAE

216. *Aconitum flavescens*—“Imalaya Mts” (epithet not in Merrill)
217. *Anemone umbellata* Lam.
218. *Botrophis sibirica*—“Sib” (epithet not in Merrill)
219. *Caltha parviflora*—“N. Sp. Raf.” “Labrador and Belgica” (epithet not in Merrill)
220. *Clematis florida* Thunb. “of China”—“China”
221. 388—*Dipleina umbellata*—“Sibiria(?)”

RHAMNACEAE

222. *Paliurus spincicristi* (*spina-Christi*) Mill.—“Palestina”

ROSACEAE

223. 80—*Duchesnia fragaroides* (*fragarioides*) Sm.—“N G fr. Sibirica”
224. *Geum intermedium*—“Sibirica” Herb. Raf., p. 50
225. 1266—*Geuncus renifolius*—“Sibiria” Text of Aut. Bot. gives “*Geum renifolium*”; Merrill marks 1265, “*Geuncus*,” as nom. nov. provis.
226. *Malus sibiricus* (*sibirica*) Borckh.
227. 1215—*Potentilla atrosang* (*atrosanguinea*)—“Nepaul”
228. 1221—*Potentilla egyptiaca*—“Egypt”
229. 1232—*Potentilla subacaulis*—“Bohemia” CSR: *Dasiphora subacaulis*
230. *Rubus ideus* (*idaeus*) L.—“Labrador”
231. *Spiraea bacteata*—Other name on label not Raf., *Spiraea levigata*, Sylva Tellur. 151

RUBIACEAE

232. Bouvardia coccinea—“Texas” CSR: *Houstonia ochroleuca*, Ann. Gen. Sci. Phys. 5: 226
233. *Chiococca latif*—“Cuba” Alsogr. Am. 75
234. *Drakanos siculus*—“Mts Palermo” 3 line label Raf. hand, not in Merrill
235. 501—*Sherardia*—*Lomake*, Aut. Bot. 73 Verbenaceae

RUTACEAE

236. *Aucuba japonica* Thunb.—“*hortex*”
237. *Diosma obovata*—Not in Merrill

SALICACEAE

238. 13—*Ripsoctis egyptiaca*

SAPINDACEAE

239. N. Fl. N. Am. 531—*Sapindus acuminatus* (*acuminata*–N. Fl.)—“Florida” “Mts Apal” N. Fl. N. Am. 3: 22, No. 531

SAXIFRAGACEAE

240. “*Heuchera? corymbosa*”—“900 New Fl” Not in New Fl., epithet not in Merrill
241. *Heuchera parviflora*—“134 *Heuchera parviflora* Raf 1820 Mts Cumberland V.” First Cat. Bot. Gard. Trans. p. 14
242. 1085—*Philadelphus discolor*
243. 1083—*Philadelphus grandifl* (*grandiflorus*)—“in hortis”
244. *Ribes alpinum* L.—CSR: *Imbutis*, Herb. Raf. 54

SCROPHULARIACEAE

245. 1144—*Antirrhinum junceum*—“Eur. Australis” Text: “*Antirhinum*”; epithet nom. nov. provis.
246. 1149—*Antirrhinum sparteum*
247. *Celsia heterophyla* Desf.—“Sicilia” Other data illegible

248. 1155—*Linaria triphylla* Mill.—"Grecia" (*Antirhinum triphylum* of Aut. Bot.)
249. *Lophospermum scandens* D. Don.—"N. Mex. Texas"
250. 84—*Maurandia berkleyana*—"Australia" Not in Merrill
251. (156) 1156—*Peloria linaria*—Under both numbers in Aut. Bot.
252. 1166—*Probatea lobata*—"Sibiria"
253. 1165—*Probatea grandifl*—Has original label *Antirrhinum anserina* not in Raf. hand, see Aut. Bot. 158
254. 1192—*Scrophularia capitata*—*Scrophularia vernalis* on original label, also Baviere
255. 1170—*Termontis sicula*
256. 784—*Verbascum pyramidale*—"*S. macrophyl* Asia"
257. 775—*Verbascum undulatum*—"Creta"
258. *Veronica incisa* Opiz.—"Sibiria"
259. 1379—*Zeliarus repens* (*Zeliauros*)—"Hisp and Maroc." 4 line label description in Raf. hand, Text: "Zeliauros"

SOLANACEAE

260. 101—*Levana uniflora*—"South Africa" 7 line Latin label in Raf. hand
261. *Nicot plumbaginea* (*plumbaginifolia*) Willd. (*Nicotiana*)—"M Video"
262. 764—*Parmentiera balduini*—Dr. Baldwin original label
263. 762—*Solanum pilosum*—Original label not in Raf. hand is "*Solanum decurrens*," see Aut. Bot. p. 108

THYMELAEACEAE

264. 1058—*Daphne collina* Sm. (*Daphne sericea*)—"Syria"
265. 1062—*Daphne undulata*—"Sibiria"
266. 1068—*Sanamunda adpressa*—Original label, not Raf. hand, is *Passerina filiformis*, see Aut. Bot. p. 147
267. 1067—*Sanamunda axillaris*—"So Afr"
268. 1066—*Sanamunda grandiflora*
269. 1070—*Sanamunda subulata*—Original label has *Gnidia pinifolia*, not Raf. hand, see Aut. Bot. p. 147
270. 1069—*Sanamunda umbellata*—"South Africa"
271. (62) 1072—*Strusiola scoparia*—[see 1072, replaces 62] Raf. hand "see 1072 Autik 62 Aut"; original label has *Dessenia scoparia* in Raf. hand, also *Struthiola erecta* not Raf.

UMBELLIFERAE

272. *Cachrys ciliata*—"Creta" CSR: *Apolgusa*, Good Book 57 (epithet not in Merrill)
273. *Caucalis nodiflora*—"Sic" Not in Merrill
274. *Echinophora tenuifolia* L.—"G. Creta"
275. *Eryngium azureum*—"Palestina" (epithet not in Merrill)
276. *Eryngium pentechinum* Sieber—"Palest"
277. *Lomatium athamanthoides*—"Neuch"?? Good Book p. 55

ZYGOPHYLLACEAE

278. *Zygophyllum coccineum* L.—"Egypt"
279. *Zygophyllum simplex* L.—"Egypt"

PART III. Specimens that state "from Raf." or "Rafinesque herbarium" but do not have Rafinesque's handwriting on the label. All the specimens came to Darlington from Durand.

COMPOSITAE

280. *Aster Shortii* Lindl.
281. *Centaurea*
282. *Coreopsis olioscoidea*—Specific epithet not in Merill
283. *Helianthus hirsutus*—Annals of Nature p. 14
284. *Helianthus microcephalus* Torrey & Gray
285. *Solidago Shortii* Torrey & Gray—4 line comment by Wm. Darlington

GRAMINEAE

286. No name—Appears to be *Leersia oryzoides*

PINACEAE

287. *Thuja occidentalis* L.

PART IV. Specimens from Durand to Darlington that have a note "Raf." or "Rafin." on the label, but were not in Rafinesque's handwriting.

ACERACEAE
288. *Acer tataricum* L.

CAPRIFOLIACEAE
289. *Sambucus nigra*—"Bohemia"? CSR: *Sambucus alba*, Alsogr. Am.

CHENOPODIACEAE
290. *Blitum* L.
291. *Chenopodium scorparia* L.

COMPOSITAE
292. *Hieracium foliosum* Waldst. & Kit.

EUPHORBIACEAE
293. 369—*Croton glandulosum*—Label states S. America? Darlington's hand; CSR: *Pleopadium ciliatum*
294. 371—*Croton plicatum*— CSR: *Crozophora plicata*

LABIATAE
295. No Label—Label: Rafin? From E. Durand
296. *Dracocephalum* L. (two collections)
297. *Scutellaria alpina* L.—Label gives locality as Swiss Alps, Darlington hand.

LEGUMINOSAE
298. *Vicia peregrina* L.

MORACEAE
299. 1090—*Broussonetia papyrifera*—CSR: *Papyria*, Am. Man. Mulberry Trees p. 9

PRIMULACEAE
300. *Lysimachia puncata* L.—"Raf. is not to be trusted for localities" "Germany" Wm. Darlington

RANUNCULACEAE
301. *Ranunculus nivalis* L.—"Raf." on label, not Raf. hand

SCROPHULARIACEAE
302. 1156—*Peloria genistifolia*

VIOLACEAE
303. *Viola arborescens* L.—Label gives "ex Hispania"

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Bartonia No. 53: 34–40, 1987

"Moss" Collections of John Bartram and Angiosperm Collections of James Cuninghame in *Horti Sicci* 332 of the Sloane Herbarium

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"Moss," during the 17th and 18th centuries, was a general term that included mosses, hepatics, lichens, and algae (Buck and McLean 1985). The growth of interest in all exotic plants, including the "lower" plants, provided additional employment for collectors such as John Bartram, who sent specimens to England for cultivation or for scientific description. Thus, John Bartram came to send "mosses" to Sir Hans Sloane during the years 1742 and 1743 either directly or through Peter Collinson. The specimens documented here are apparently not duplicates of earlier collections such as those sent to Robert James (Lord Petre) in 1741. Indeed, only one specimen is definitely an earlier collection from Virginia, where Bartram traveled in 1738. Two of Bartram's collections in the Sloane herbarium are potential isotypes; these are from the Syracuse region "Five Nations Countrey" that Bartram visited in the summer of 1743.

Bartram's moss collections were bound as one of the *Horti Sicci* (*H.S.* 332) in the Sloane Herbarium in 1888 by the British Museum (Natural History), and are located among special collections in the General Herbarium. The first five numbers in *H.S.* 332 are James Cuninghame's material from the East Indies, collected before 1709 (Dandy 1958). The collection provides, together with those in the herbarium of Robert James, Lord Petre, in the Sutro Library (McLean 1984; Buck and McLean 1985), the earliest known collections of 94 species from New Jersey, Pennsylvania, Virginia, and New York.[1]

Bartram's correspondence with Hans Sloane, Peter Collinson, and John Jacob Dillenius during 1743 and 1744 pertains in part to his collections in *H.S.* 332. Although he sent duplicates to Sloane and Collinson, there is no known evidence of exact duplication in *H.S.* 332 and any other contemporary collections.

After Bartram's return from the Syracuse region, he also sent specimens directly to Dillenius as recorded in his letter to Dillenius dated 29 November 1743 (Darlington 1849), "I have sent two or three sorts of mosses, that I gathered in the country of the Five Nations which I think are a little different from any that thee has figured [i.e. in *Historia Muscorum,* Dillenius 1741]." Any types to be found are thus duplicates of *H.S.* 332:11 (*Climacium americanum*) or *H.S.* 332:25 (*Hylocomium splendens*) sent directly to Dillenius for examination after Bartram had seen *Historia Muscorum.*

Prior to 1986, there was no concerted effort to identify the collections in *H.S.* 332. Sloane was 84 years old when the specimens arrived in England late in 1743. Despite Sloane's extensive correspondence with naturalists throughout the world, rather few of the specimens sent to him during his later years received much attention until this century.

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[1] John Bartram's travels before 1743 are documented (Cruickshank 1957; Berkeley and Berkeley 1982); a summary of his travels is found in Ewan's introductions to the facsimile edition of Darlington (1967).

Because of the number of flowering plants collected for Sloane by Bartram and bound as *Horti Sicci* 334, *H.S.* 334 has had more attention; Solander identified many plants at the beginning of the collection (Dandy 1958) and Joseph Ewan also annotated the collections in 1955 and 1975. Cursory notes were made on cryptogams in *H.S.* 332 and in *H.S.* 334 by Carlotta Herring-Browne of Philadelphia.[2] However, there are comparatively few notes on the cryptogams in either volume, save for Bartram's habitat notes and Herring-Browne's determination labels.

All collections in *H.S.* 332 were identified in August 1986. The five East Indian vascular plants collected by James Cuninghame bound at the beginning of *H.S.* 332 were identified by Caroline Whitefoord. The Bartram cryptogamic specimens (72 collections) were identified by the author with the assistance of J. R. Laundon and A. J. Harrington: 41 mosses, 17 lichens, four hepatics, two lycopods, *Selaginella rupestris*, and *Enteromorpha* (an alga). Identification of lichens does not at present include lichen chemistry. Guides to the identification of North American cryptogams include Gleason (1952), Fernald (1950), Crum and Anderson (1981), Hale (1966, 1970), Hale and Culberson (1966), and Schuster (1949, 1966–1980).

The following numbered identifications and notes on all collections in *H.S.* 332 include Cuninghame's or Bartram's habitat notes in quotation marks. For the first number of each species collected by Bartram, the known range of the species at present is included, together with notes on morphology where useful.

Introductory notes at the beginning of *H.S.* 332 are misleading, because of the inclusion of five East Indian angiosperms from Cuninghame's earlier collections:

> . . . "Herbs and moss gathered and dried by [?James Cuninghame/?John Bartram] in the east Indies Julius 1742 with some account of the virtues of some of them" . . . (m. Sir Hans Sloane) . . .

in pencil:

> ". . . except for the first five are North American crypt[ogams] chiefly mosses and lichens from John Bartram" . . . (m. Robert Brown *circa* 1888) as verified by Dandy (1958).

EAST INDIAN ANGIOSPERMS COLLECTED BY JAMES CUNINGHAME

The notes are in James Cuninghame's hand; thus, these specimens were collected prior to his death in 1709; the exact locations are uncertain. Reference to the presence of Cuninghame material in *H.S.* 332 is found in Dandy (1958) under the biographical reference but not in the enumeration of *Horti Sicci*.

1. *Alternanthra sessilis* (L.) D.C. "*Du'due'ke* so called in the Canares Language, it Groeth Creping on the Ground; hath a Leaff Like a purslane is very full of wite tufs of Flowers like Batheldors Butons but I am ignorent of its vartew."
2. *Cynodon dactylon* (L.) Pers. "*Dor'ca*' this Harb Likwise Lyeth Spreding on the Ground Like the Stalk Geliflower and is of the Gras speces: it Bareth no Flower etc."
3. *Aerva lanata* Juss. "*Tom'*ba this Harb Bareth up is head and Floowers Like Lavender coton its Leaff when Yoing is Rownd and Broad as an English Shilling it is of Espesiall vartew in phisech of or a Grean Wound the Nateves Use it the Chewing it in thare mouths and aplying it to the part aflecketed aspeses wharof take as foloweth:"
4. *Solanum* cf. *indicum* auct. non L. (possibly *S. angeuivii* Lamarck, the specimen lacks flowers, and is quite young). "*Boe'rongo'ne* in the Canares but by the Portugues is caled *Bringalle De Mato:* or the Ground Thistle it Groeth in the wild and Baran places Baring a Leaff in Shape Like the oake and named in that maner one the Ridges of which Nerves Shuteth up Long and Sharp thistles, some whereof are an Inch

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[2] Carlotta Herring-Browne was a member of the Cryptogam Society of Philadelphia at the University of Pennsylvania ca. 1907.

Long, its couler is a Dark Green and is Good and Holsom Remady: Given in Feavors; the Rute thareof is Penetrating and Extends its self in to the Ground a Larg Depth this is Like wise an holsom Ramady Given to any afflicted with a Pain in the Bath and generaly hath those Good Efeckts."

5. *Sida cordatum* (Burm.) van Boors. Waalk. "*Ca'len'de* is a Broad spreding Herab: having a Leaff Like to a Hart Jagd at the point: the under part Bering somthing wolly, as is Like wise the stem: which with the Leaves shuteth out short stembs in which it Bareth a Yalow Flower Like the Buterflower but much Smaller in the center wharof is the Sead which Resembleth the Flower in Coloour in is of a medcinell vartew being Like wise Estemd Good in Feavers."

North American Collections by John Bartram

The following numbers (6–8; 10–80) are North American cryptogams (lycopods, bryophytes, lichens, and one marine alga); number 9 is a flowering plant and number 81 has not been identified. Many were probably collected in southeastern Pennsylvania, although where Bartram indicated, the collections are from Virginia, (New) Jersey, and New York.

6. *Lycopodium alopecuroides* L. "this grows in flat moist ground." Acid bogs and on moist banks of the coastal plain (Gleason 1952).
7. *Lycopodium* cf. *porophilum* Lloyd & Underw. (*L. selago* var. *patens* (P.-Beauv.) Desv.) "this growed in moist ground in a shady place." Common in eastern temperate forests of North America on rocks in acid soil (Gleason 1952).
8. *Leucobryum albidum* (Brid.) Lindb. "this growed in a bank near a run of water." Common in eastern North America.
9. *Tillandsia usneoides* L. "this moss I brought several years ago from ye eastern shore of virginia where it groweth above 6 foot long & is fine food for horses & dear it makes a fine apearance in windy weather to see it wafted to and fro, & dangling from ye tops & limbs of ye trees." "Spanish Moss" is common in the southeastern U.S. and in the neotropics. Apparently, Bartram recognized this as *Tillandsia usneoides*, although he did not distinguish it from mosses or lichens. This collection is most probably from his collections from Virginia in 1738. An identification, apparently in his hand, is dated 1743.

10a. *Polytrichum commune* L. "this growed on poor ground in ye woods." The presence of antheridial bracts indicates a spring collection. Common in eastern North America.

10b. *Thuidium delicatulum* (Hedw.) B.S.G. Common in eastern North America.

11a. *Climacium americanum* Brid. "this moss I found in ye countrey of ye five nations in a shady moist place." (New York ?) Although this species occurs from Ontario throughout eastern North America, it is more common in southern areas. A duplicate specimen may be in the Dillenian herbarium at Oxford.

11b. *Thuidium delicatulum* (Hedw.) B.S.G.

11c. *Campylium* cf. *hispidulum* (Brid.) Mitt. Eastern North America.

12. *Rhytidiadelphus triquetrus* (Hedw.) Warnst. "this growed on moist poor shady ground." Acidophilic, occurring throughout the northern U.S. and Canada.
13. *Porella platyphylloidea* (Schwein.) Lindb. "this growed on a moist rock in ye shade." This species is distinguished from *P. pinnata* by wide, rounded ventral lobes and decurrent underleaves. A Bartram *P. pinnata* collection is found in the Dillenian herbarium and is figured in *Historia Muscorum* (Dillenius 1741; Schuster 1980) as *P. pinnis obtusis*. *P. platyphylloidea* grows on partially shaded, relatively dry rocks and trees throughout eastern North America (Schuster 1949, 1980).

14a. *Anomodon rostratus* (Hedw.) Schimp. "this growed at ye root of a tree partly upon ye ground." Common in eastern North America.

14b. *Brachythecium sp.*

15. *Entodon seductrix* (Hedw.) C. Muell. "this I gathered on a tree." Common in eastern North America.

16a. *Amblystegium* cf. *tenax* (Hedw.) C. Jens. (possibly *A. fluviatile* (Hedw.) B.S.G.) "this growed in a pond of standing water." *Amblystegium tenax* and *A. fluviatile* are poorly differentiated. The former occurs throughout temperate North America and the latter grows in generally calcareous habitats in eastern North America.

16b. *Thuidium delicatulum* (Hedw.) B.S.G.

17. *Drepanocladus fluitans* (Hedw.) Warnst. "this growed in a pond of standing water." Acid, moist habitats throughout temperate and boreal North America.

18a. *Atrichum oerstedianum* (C. Muell.) Mitt. "this growed on cold clay ground." For the sake of continuity with Buck and McLean (1985), I follow Ireland's treatment of *Atrichum* (1969a), which assigns the eastern North American segregate of *A. undulatum* to *A. oerstedianum*. Grows on disturbed soil.

18b. *Pleurozium schreberi* (Brid.) Mitt. Common in boreal and temperate North America.

18c. *Rhizomnium punctatum* (Hedw.) Kop. (= *Mnium punctatum* Hedw.) I use the generic segregates of Koponen (1968) that some recognize as subgenera of the genus *Mnium* (Crum and Anderson 1981). Common in eastern North America.

18d. *Plagiomnium cuspidatum* (Hedw.) Kop. (= *Mnium cuspidatum* Hedw.) Common throughout North America in suitably mesic localities.

18e. *Thuidium delicatulum* (Hedw.) B.S.G.

18f. *Parmelia* sp. (fragment)

19a. *Anomodon rostratus* (Hedw.) Schimp. "this growed on a piece of ould wood in a moist place."

19b. *Plagiomnium cuspidatum* (Hedw.) Kop.

20. *Climacium americanum* Brid. "this growed on moist shady ground."

21. *Hedwigia ciliata* (Hedw.) P.-Beauv. "this growed on a dry rock." Cosmopolitan, generally found on acid rocks.

22a. *Grimmia* cf. *affinis* Hoppe & Hornsch. "this growed on a dry sandy rock." ± cosmopolitan, generally on dry acid rocks.

22b. *Hedwigia ciliata* (Hedw.) P.-Beauv.

23. *Anomodon minor* (Hedw.) Fuernr. "this growed on ye shady side of a rock by ye river." Common in eastern North America.

24a. *Thuidium delicatulum* (Hedw.) B.S.G. "this growed on ye bank near ye water courses."

24b. *Atrichum oerstedianum* (C. Muell.) Mitt.

24c. *Plagiomnium cuspidatum* (Hedw.) Kop.

25. *Hylocomium splendens* (Hedw.) B.S.G. "this moss I found in ye countrey of ye 5 nations in a moist shady place" [New York ?]. Common in eastern temperate and boreal North America.

26. *Aulacomnium heterostichum* (Hedw.) B.S.G. "this growed on poor ground." Common in eastern North America, particularly southward.

27. *Callicladium haldanianum* (Grev.) Crum "this growed on an ould rotten log in a swamp." Widespread in eastern North America.

28. *Hypnum curvifolium* Hedw. "this growed on a ould rotten log in ye shade." Moist shady places in eastern North America.

29a. *Cladina subtenuis* (Abb.) Evans. "this growed on a dry sandy rock." Common from Maine to South America, in North America confined to eastern portion (Thomson 1967).

29b. *Dermatocarpon* cf. *miniatum* (L.) Mann. Fragment only. Grows on calcareous rocks in North America except on the western plains.

30. *Usnea* cf. *trichodea* Ach. "this growed on ye bows of a tree in Jersey in low ground . . . it makes an excelent bright orang Color for woolens . . . it grows in great plenty in swamps." Common on trees in eastern North America.

31. *Dicranum scoparium* Hedw. "this growed in poor cold ground." The species is very common throughout eastern North America.

32. *Lobaria quercizans* Michx. "this growed on a sandy rock." Common on rocks and trees throughout eastern North America.

33. *Pogonatum pensylvanicum* (Hedw.) P.-Beauv. "this groeth on cold clay soil." Common in the habitat indicated throughout eastern North America.

34. *Cladonia verticillata* (Hoffm.) Schaer. (no notes) Cosmopolitan and widespread in disturbed, open sites.

35. *Selaginella rupestris* L. "this growed on a rock near ye riverside." Common throughout eastern North America.

36. *Grimmia* cf. *apocarpa* Hedw. "this growed on a rock by a river." Cosmopolitan.

37. *Dicranella heteromalla* (Hedw.) Schimp. "ground moss." Common in eastern North America.

38. *Umbilicaria mammulata* (Ach.) Tuck. "from ye top of a rock on ye mountain." Very common on large boulders in open woods in eastern North America.

39. cf. *Brachelyma subulatum* (P.-Beauv.) Schimp. (no notes) The moss is attached to soft (?conifer) wood and appears to have grown in an aquatic or semiaquatic habitat. Sporophytes are lacking; leaves are costate. Because of southeastern distribution, this collection may be from Virginia, if the identification proves correct.

40. *Aulacomnium heterostichum* (Hedw.) B.S.G. "upon little hilloks in moist places."

41. *Leucobryum albidum* (Brid.) Lindb. "on very poor ground."

42. *Cladonia* cf. *sylvatica* (L.) Hoffm., sens. lat. "in a shady wet place on rotten wood." Circumpolar temperate species found southward to Maryland.

43. *Lobaria pulmonaria* (L.) Hoffm. "on ye sweet gum tree near ye root." Widespread in northern hardwood forests and swamps.

44. *Atrichum angustatum* (Brid.) B.S.G. "on ye north side of a wall near ye ground." Common on eastern North America on disturbed sites.

45a. *Parmelia perforata* (Jacq.) Ach. "tree mosses." Common on exposed tree trunks and at the tops of trees as far north as southeastern New York.

45b. *Usnea strigosa* (Ach.) Eaton. Common on canopy branches of deciduous trees.

45c. cf. *Lecanora* sp.

45d. *Physcia* cf. *millegrana* Degel. Common in open woods and on rocks throughout eastern North America.

46. *Hypnum cupressiforme* Hedw. "on wet clay ground." Scattered on calcareous soil and rock throughout eastern North America.

47. *Anomodon rostratus* (Hedw.) Schimp. (no notes). Obviously on bark.

48a. *Sphagnum flexuosum* Dozy & Molk. (= *S. recurvum* P.-Beauv.). "in bogy places." Crum and Anderson (1981) and Crum (1981) use the Palisot d'Beauvior name based on a Bosc collection from South Carolina that has not been seen by recent authors, hence the use of the commonly accepted name. Widespread in temperate eastern North America.

48b. *Bazzania trilobata* (L.) Gray. Common throughout eastern temperate and boreal North America.

49a. *Pylaesiella selwynii* (Kindb.) Crum, Steere & Anderson. "tree moss two kinds." Central and eastern North America.

49b. *Amblystegium varium* (Hedw.) Lindb. Widespread throughout central and eastern North America.

49c. *Plagiomnium cuspidatum* (Hedw.) Kop.

50a. *Lycopodium* cf. *porophilum* Lloyd & Underw. "in wet shady woods."

50b. *Thuidium delicatulum* (Hedw.) B.S.G.

51a. *Callicladium haldanianum* (Grev.) Crum "in shady places on rotten wood."

51b. *Hypnum curvifolium* Hedw.

52. *Selaginella rupestris* L. "on a rock by ye river."

53. *Leucodon julaceus* (Hedw.) Sull. "upon ye barks of trees in shady woods." Widespread in central and eastern North America.

54. *Anomodon attenuatus* (Hedw.) Hüb. "on poor soil." Widespread in central and eastern North America.

55. *Lycopodium alopecuroides* L. "this runs trailing on ye ground in Jersey in poor hucke berry bottoms."

56a. *Parmelia perforata* (Jacq.) Ach. "on a sweet gum tree."

56b. *Usnea strigosa* (Ach.) Eaton

56c. *Physcia* cf. *millegrana* Degel.

57. *Cladonia pyxidata* (L.) Hoffm. "on poor dry ground." Cosmopolitan, generally on mineral soil and more common northward.

58a. *Dicranum fuscescens* Turn. "on roots of trees in ye shade." Circumpolar, often found as described, and may occur mostly in acid conditions.

58b. *Solenostoma* sp.; mixed collection

59a. *Thuidium delicatulum* (Hedw.) B.S.G. "on poor soil."

59b. *Atrichum oerstedianum* (C. Muell.) Mitt.

60. *Bryoandersonia illecebra* (Hedw.) Robins. "on ye bark of ould trees in ye shade." Widespread in eastern North America, more common southward.

61a. *Conocephalum conicum* (L.) Dumort. "on shady wet rocks. it smells well when fresh." Abundant and widespread.

61b. *Hypnum* cf. *curvifolium* Hedw.

62. *Cladonia* cf. *uncialis* (L.) Wigg. sens. lat. "ground moss on poor soil." Cosmopolitan and grows on mineral soil or among mosses.

63a. cf. *Plagiothecium denticulatum* (Hedw.) B.S.G. "in a shady swamp." Widespread in woods on humic substrates (Ireland 1969).

63b. *Rhytidiadelphus triquetrus* (Hedw.) Warnst.

63c. Imperfect lichen, cf. *Lepraria* sp.

64. *Bryum argenteum* L. "ground moss near a copper mine." Ubiquitous, but may not have been as much so in the 18th century.

65. *Pogonatum pensilvanicum* (Hedw.) P.-Beauv. "this grows in poor steep clay banks."

66a. *Thuidium delicatulum* (Hedw.) B.S.G. "on poor sandy soil in ye woods."

66b. *Atrichum oerstedianum* (C. Muell.) Mitt.
67a. cf. *Plagiothecium denticulatum* (Hedw.) B.S.G. "on a moist rock by ye river where ye tide flowes."
67b. cf. *Solenostoma* sp.; quite mixed collection.
68a. *Porella platyphylloidea* (Schwein.) Lindb. "on moist rocks."
68b. *Bryoandersonia illecebra* (Hedw.) Robins.
69a. *Anomodon rostratus* (Hedw.) Schimp. "on ye barks of trees near ye ground or on rocks."
69b. *Porella platyphylloidea* (Schwein.) Lindb.
70a. *Hypnum imponens* Hedw. "on ye ground in moist woods." Widespread in eastern North America.
70b. *Dicranum scoparium* Hedw.
71. *Drepanocladus fluitans* (Hedw.) Warnst. "in a pond on a ould log."
72. *Dicranum scoparium* Hedw. (no notes; apparently on organic soil)
73a. *Brachythecium* sp. "on poor soil."
73b. *Rhizomnium* cf. *punctatum* (Hedw.) Kop.
74a. *Cladonia pyxidata* (L.) Hoffm. "on very poor dry ground."
74b. *Hedwigia ciliata* (Hedw.) P.-Beauv.
75a. *Parmelia perforata* (Jacq.) Ach. (no notes; obviously corticolous)
75b. *Physcia* cf. *millegrana* Degel.
75c. cf. *Lecidia* sp.
76. *Cladonia verticillata* (Hoffm.) Schaer. (no notes; soil particles adherent)
77. *Grimmia* cf. *apocarpa* Hedw. "on a rock by ye river."
78. *Philonotis fontana* (Hedw.) Brid. sens. lat. "in a miery springy place." Common in seepy habitats throughout North America.
79. *Hedwigia ciliata* (Hedw.) P.-Beauv. "on moist clay." Although the habitat seems odd, the specimen has the characteristic pluripapillose leaves and is ecostate, with a reddish central area where leaf joins stem.
80. cf. *Enteromorpha* sp. "sea moss."
81. Unidentifiable fragment. (no notes)

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Bartonia No. 53: 41–43, 1987

Vascular Plants in Lord Petre's Herbarium Collected by John Bartram

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Volumes XI and XII of Lord Petre's herbarium in the Sutro Library at San Francisco State University contain 155 specimens (145 species) of vascular plants collected by John Bartram in eastern North America before 1742. These specimens were sent to his friend and botanical correspondent, Peter Collinson (1694–1768) in England, who then sent them to Robert James (1713–1742), the eighth baron Petre (McLean 1984). Many of these specimens have data in Bartram's hand (McLean 1984) and many, particularly those in vol XI, lack data.

The importance of these specimens is more historic than scientific. They apparently were not examined by botanists who were publishing descriptions of plants at that time although a few duplicates may have been examined by such botanists. The specimen of *Lycopodium obscurum* (XII, 11) may be a duplicate of the specimen upon which Dillenius (1741) based his description that was cited by Linnaeus (Buck and McLean 1985). The specimens of *Panax quinquefolius* (XI, 15; XII, 17) may be duplicates (or the same specimens?) of the two specimens mentioned by Gronovius (1739) as being "In Phytophylacio Collinsoniano." The specimen of *Phlox paniculata* (XI, 26) may be a duplicate of the Collinson specimen cited by Linnaeus (1753). It is also possible that the specimen seen by Linnaeus came from plants in Collinson's garden that originally came from Bartram (Wherry 1955). The Bartram specimen of *Xerophyllum asphodeloides* cited by Linnaeus (1762) probably was sent after 1741. However, it may have come from a plant in Bartram's garden that also was the source of the specimen (XI, 71) in Lord Petre's herbarium.

We do not know how many duplicates of specimens in Lord Petre's herbarium exist today. We do know that another specimen of *Delphinium exaltatum* (XI, 44), which has spurless flowers, is in the British Museum (Natural History). It is probable that duplicates of more specimens exist because Bartram is known to have sent duplicates to his correspondents (Darlington 1849; Buck and McLean 1985). A search through collections at the British Museum may prove productive in this regard.

The historic importance of these specimens is that they help us better understand the botanical expertise of John Bartram. As we identified the plants, we soon realized that we were not working with an ordinary assemblage of specimens. Included are plants of the seashore, pine barrens, and mountains, plants of acid substrates and limestone, and plants of aquatic and terrestrial habitats. We know his critical selection of diverse plants impressed his correspondents and now we have tangible proof of what impressed them.

The Bartram specimens in Lord Petre's herbarium are all within the geographical range of Bartram's early travels from Virginia to New York (Berkeley and Berkeley 1982). In addition to native species, he also collected seven species considered to be introductions (Fernald 1950): *Achillea millefolium* (XI, 93), *Aethusa cynapium* (XII, 42), *Centaurea calcitrapa* (XI, 57), *Lamium amplexicaule* (XII, 56), *Mollugo verticillata* (XII, 49), *Scleranthus annuus* (XI, 90), and *Stellaria graminea* (XI, 85). Thus we know these plants have been in America for a long time although they may have been uncommon enough in the 18th century for Bartram to think he found something unusual.

The following list gives the vascular plant specimens collected by John Bartram in volumes XI and XII of the Lord Petre herbarium. In these volumes there also are a few specimens (XII, 1, 64–70) that apparently are Houstoun collections from the West Indies as well as one unidentified moss specimen (XII, 4) collected by Bartram.

We thank Joseph Ewan, Elizabeth P. McLean, Ann F. Rhoads, and Ronald L. Stuckey for their interest, comments, and help with various aspects of our work.

Volume XI. 2. *Asplenium rhizophyllum* L. 3. *Maianthemum canadense* Desf. 4. *Actaea pachypoda* Ell. 5. *Asarum canadense* L. 6. *Helenium autumnale* L. 7. *Epifagus virginiana* (L.) Bart. 8. *Spiranthes cernua* (L.). Rich. 9. *Clintonia borealis* (Ait.) Raf. 10. *Agalinis purpurea* (L.) Penn. 11. *Salvia lyrata* L. 12. *Mitella diphylla* L. 13. *Hydrastis canadensis* L. 14. *Matelea obliqua* (Jacq.) Woods. 15. *Panax quinquefolius* L. 16. *Hedyotis caerulea* (L.) Hook. 17. *Thalictrum dioicum* L. 18. *Thalictrum dioicum* L. 19. *Hypericum canadense* L. 20. *Napaea dioica* L. 21. *Cacalia suaveolens* L. 22. *Eupatorium coelestinum* L. 23. *Eupatorium hyssopifolium* L. 24. *Phlox maculata* L. 25. *Phlox pilosa* L. 26. *Phlox paniculata* L. 27. *Phlox ovata* L. 28. *Phlox pilosa* L. 29. *Calopogon tuberosus* (L.) BSP. 30. *Salvia urticifolia* L. 31. *Asclepias verticillata* L. 32. *Stachys hyssopifolia* L. 33. *Coeloglossum viride* (L.) Hart. 34. *Eupatorium hyssopifolium* L. 35. *Pycnanthemum verticillatum* (Michx.) Pers. 36. *Parthenium integrifolium* L. 37. *Cypripedium acaule* Ait. 38. *Astragalus canadensis* L. 39. *Physostegia virginiana* (L.) Benth. 40. *Helenium autumnale* L. 41. *Onosmodium hispidissimum* Mackenz. 42. *Lobelia elongata* Small. 43. *Delphinium carolinianum* Walt. 44. *Delphinium exaltatum* Ait. 45. *Gentianella quinquefolia* (L.) Small. 46. *Oenothera fruticosa* L. 47. *Hypericum stans* (Michx.) Adams & Robson. 48. *Lechea minor* L. 49. *Krigia biflora* (Walt.) Blake. 50. *Aethusa cynapium* L. 51. *Rhexia virginica* L. 52. *Asclepias tuberosa* L. 53. *Scutellaria integrifolia* L. 54. *Platanthera ciliaris* (L.) Lindl. 55. *Linum virginianum* L. 56. *Zizia aurea* (L.) Koch. 57. *Centaurea calcitrapa* L. 58. *Equisetum fluviatile* L. 59. *Equisetum hyemale* L. 60. *Eryngium yuccifolium* Michx. 61. *Agalinis tenuifolia* (Vahl) Raf. 62. *Sabatia campanulata* (L.) Torr. 63. *Minuartia caroliniana* (Walt.) Mattf. 64. *Phlox divaricata* L. 65. *Trifolium reflexum* L. 66. *Buchnera americana* L. 67. *Linaria canadensis* (L). Dum.-Cours. 68. *Tomanthera auriculata* (Michx.) Raf. 69. *Pedicularis canadensis* L. 70. *Amianthium muscaetoxicum* (Walt.) Gray. 71. *Xerophyllum asphodeloides* (L.) Nutt. 72. *Castilleja coccinea* (L.) Spreng. 73. *Viola pedata* L. 74. *Lobelia spicata* Lam. 75. *Campanula rotundifolia* L. 76. *Medeola virginica* L. 77. *Carex blanda* Dew. 78. *Tridens flavus* (L.) Hitchc. 79. *Carex lupulina* Muhl. 80. *Carex alata* Torr. 81. *Panicum boscii* Poir. 82. unknown grass. 83. *Equisetum arvense* L. 84. *Pyxidanthera barbulata* Michx. 85. *Stellaria graminea* L. 86. *Polygonum scandens* L. 87. *Senecio aureus* L. 88. *Parnassia glauca* Raf. 89. *Utricularia fibrosa* Walt. 90. *Scleranthus annuus* L. 91. *Lithospermum caroliniense* (Gmel.) MacM. 92. *Ipomea pandurata* (L.) Mey. 93. *Achillea millefolium* L. 94. *Geranium carolinianum* L. 95. *Limonium carolinianum* (Walt.) Britt.

Volume XII. 3. *Comptonia peregrina* (L.) Coult. 5. *Diervilla lonicera* Mill. 6. *Prunus pensylvanica* L.f. 7. *Acer pensylvanicum* L. 8. *Ceanothus americanus* L. 9. *Lechea* *maritima* Leggett. 10. *Clethra alnifolia* L. 11. *Lycopodium obscurum* L. 12. *Viburnum nudum* L. 13. *Saxifraga pensylvanica* L. 14. *Potentilla palustris* (L.) Scop. 15. *Hydrophyllum canadense* L. 16. *Sonchus asper* (L.) Hill. 17. *Panax quinquefolius* L. 18. *Polygonum cilinode* Michx. 19. *Polygala lutea* L. 20. *Acalypha rhomboidea* Raf. 21. *Sium suave* Walt. 22. *Solidago puberula* Nutt. 23. *Galium boreale* L. 24. *Polygonella articulata* (L.) Meissn. 25. *Saxifraga virginiensis* Michx. 26. *Eriophorum gracile* Koch. 27. *Lithospermum canescens* (Michx.) Lehm. 28. *Tiarella cordifolia* L. 29. *Ranunculus trichophyllus* Chaix ex Vill. 30. *Potentilla tridentata* Soland. 31. *Cornus canadensis* L. 32. *Trientalis borealis* Raf. 33. *Polygala paucifolia* Willd. 34. *Geum rivale* L. 35. *Solanum carolinense* L. 36. *Waldsteinia fragarioides* (Michx.) Tratt. 37. *Pluchea odorata* (L.) Cass. 38. *Lonicera dioica* L. 39. *Lonicera dioica* L. 40. *Decodon verticillatus* (L.) Ell. 41. *Epigea repens* L. 42. *Aethusa cynapium* L. 43. *Cuphea viscosissima* Jacq. 44. *Ruellia strepens* L. 45. *Eupatorium rugosum* Houtt. 46. *Lonicera sempervirens* L. 47. *Helenium autumnale* L. 48. *Gnaphalium purpureum* L. 49. *Mollugo verticillata* L. 50. *Nyssa sylvatica* Marsh. 51. *Viburnum nudum* L. 52. *Corylus cornuta* Marsh. 53. *Gentiana autumnalis* L. 54. *Cenchrus tribuloides* L. 55. *Prunus maritima* Marsh. 56. *Lamium amplexicaule* L. 57. *Lathyrus maritimus* (L.) Bigel. 58. *Plantago maritima* L. 59. *Ilex opaca* Ait. 60. *Aster tenuifolius* L. and *Sarracenia purpurea* L. 61. *Lonicera sempervirens* L. 62. *Baccharis halimifolia* L. 63. *Abies balsamea* (L.) Mill.

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The Status of *Cryptogramma stelleri, Matteuccia struthiopteris,* and *Ophioglossum pusillum* in West Virginia

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Several species of ferns reach the known southern limits of their natural ranges in the eastern states in or near West Virginia. No reports have discussed the status of these species in West Virginia since the publications of Brooks and Margolin (1938) and Wherry (1939). The current distribution, habitat and status of three of these species, *Cryptogramma stelleri, Matteuccia struthiopteris* var. *pensylvanica,* and *Ophioglossum pusillum,* are discussed here. Nomenclature follows Lellinger (1985) for pteridophytes, Kartesz and Kartesz (1980) for flowering plants, and Cardwell et al. (1968) for geologic strata.

Cryptogramma stelleri (Gmel.) Prantl.

In July 1938, E. T. Wherry discovered a colony of the fragile rock-brake in the Dry Fork Valley of Randolph County (Wherry 1939). Except for a small group of botanical associates, Wherry had not disclosed the location to anyone for fear the population would be eradicated by collectors (Wherry 1939). With land-use changes, including a ski resort and a proposed freeway, coming to the Dry Fork Valley, Breiding was stimulated to relocate the population on 6 June 1978. Both of us revisited the site on 27 August 1983. After a thorough search, only ten plants could be found, none of which appeared as vigorous as in a photograph of the population taken by Wherry. The colony is on a shaded, north-facing ledge of Mississippian-age limestone of the Greenbrier Group, at an elevation of 930 m. Associated plants include *Asplenium platyneuron, Dryopteris marginalis, Polystichum acrostichoides, Cystopteris tenuis, Aquilegia canadensis,* and *Aristolochia macrophylla.* The canopy consists of *Acer saccharum, A. nigrum,* and *Tilia americana.* The ledge is in a woodlot surrounded by pasture; sheep and cattle use the woodlot for shade. *Rosa multiflora* has invaded the woodlot and has spread onto the rock ledge. The resulting opening of the woodlot from livestock also appears to be drying the ledge. Extensive searches on limestone outcrops in the mountain counties have not revealed any additional populations. The next closest population is 320 km to the north in Pennsylvania, where there is only one known extant population (Davison 1985).

Matteuccia struthiopteris var. **pensylvanica** (Willd.) Morton

As an escape from cultivation, the ostrich fern is becoming a common plant in the lower elevations of West Virginia. Large colonies have developed on the floodplain and adjacent slopes along the Potomac River in Berkeley and Jefferson counties, about old homesites in Mineral County, and on the floodplain of the Ohio River from Wetzel County south into Wood county (Bartgis pers. obs.). The first native population discovered in the state was found along Gandy Creek near Whitmer, Randolph County, in

1918 by Wherry (1939). A second native population was found by Wherry and J. E. Benedict, Jr., on 11 July 1938 near Unus, Greenbrier County (Wherry 1939).

Subsequently, *Matteuccia* has been found to occur along Gandy Creek from near the headwaters above the Sinks of Gandy to its junction with the Dry Fork of Cheat River, a distance of 21 km. *Matteuccia* also occurs along the Dry Fork from the mouth of Gandy Creek downstream to Jenningston, Tucker County, a distance of 27 km. S. Norris (pers. comm.) found *Matteuccia* along the Laurel Fork of Cheat River on 4 September 1982 and it has subsequently been found along 4.8 km of that stream. All of these populations are mostly in Randolph County. Only one site has been found along the main stem of the Cheat River, where G. Rossbach collected it below St. George, Tucker Co., in 1976 (WVA 9293). All of these stations occur between elevations of 820 and 1180 m, except for the St. George station which is at 510 m. These stations are on alluvium derived from the surrounding Devonian shales and sandstones of the Hampshire Formation and Greenbrier limestones, except for the St. George station which is in an area of Devonian shales and sandstones of the Chemung Group.

The stations on the Dry Fork and along Gandy Creek are widely separated along the streams and usually consist of less than fifty individuals. Many are in areas used by cattle and the plants do not appear vigorous. Some of the stations along Gandy Creek are on federal lands of the Monongahela National Forest. The known Laurel Fork stations are in the Laurel Fork North National Forest Wilderness Area; these stations are not damaged by livestock and are more vigorous.

The Greenbrier County site of Wherry and Benedict was relocated by Bartgis on 24 August 1984 and the population of approximately 135 plants is thriving. The plants occur on a cool north-facing clay bank on Greenbrier limestone where a large stream sinks underground, at an elevation of 680 m. The canopy consists of *Aesculus flava, Tilia heterophylla,* and *Liriodendron tulipifera.* Although the sink is in a pasture, the cattle avoid the rugged area of the sink. Excluding here and the similar Sinks of Gandy location, *Matteuccia* has not been found to date at other cave entrances in the state. The Greenbrier County station is the southernmost known native location for *Matteuccia* in the East, occurring 110 km south of the nearest site in Randolph County.

Ophioglossum pusillum Raf.

The northern adder's-tongue fern has been largely ignored by botanists in the state, with West Virginia literature treating it only as a variety of *O. vulgatum* L. (Strausbaugh and Core 1977). The only known previous collections of the species in West Virginia were by E. M. McNeil at Dunmore and P. D. Strausbaugh at Greenbank in 1931 (WVA). Both sites are in the mountains of Pocahontas County. A 1976 collection by W. Grafton (WVA) from near Mingo, Randolph County, may also represent this species. On 6 June 1985 Bartgis discovered a vigorous population of over one hundred plants in a moist, acidic meadow atop Cranberry Mountain, Pocahontas County, at an elevation of 1170 m. The population is on federal land in the Monongahela National Forest. A species typically found north of the glacial boundary, it has been reported from as far south as Kentucky (Cranfill 1980). The species has been reported from Highland County, Virginia (Wagner and Wagner 1979) and several southern Pennsylvania counties (Wherry et al. 1979), indicating additional West Virginia populations may be found. The species' southern counterpart, *O. pycnostichum* (Fern.) Love and Love, has been reported in West Virginia only from elevations below 900 m.

SUMMARY

Of the three species, *Matteuccia struthiopteris* is the most secure in the state, occurring in several drainages in three counties. One population, in a wilderness area, appears safe from extirpation and some of the population along Gandy Creek is on federal land. Additional native colonies may yet be found in the state, specially in regions of Greenbrier limestones in the Cheat River drainage. *Ophioglossum pusillum* appears to be very rare in the state, although no thorough survey has been made of other high elevation meadows. The known extant population, on national forest land, may decline if the meadow is not maintained. Unfortunately, *Cryptogramma stelleri,* the most disjunct of any northern pteridophyte found in West Virginia, appears to be declining.

ACKNOWLEDGEMENTS

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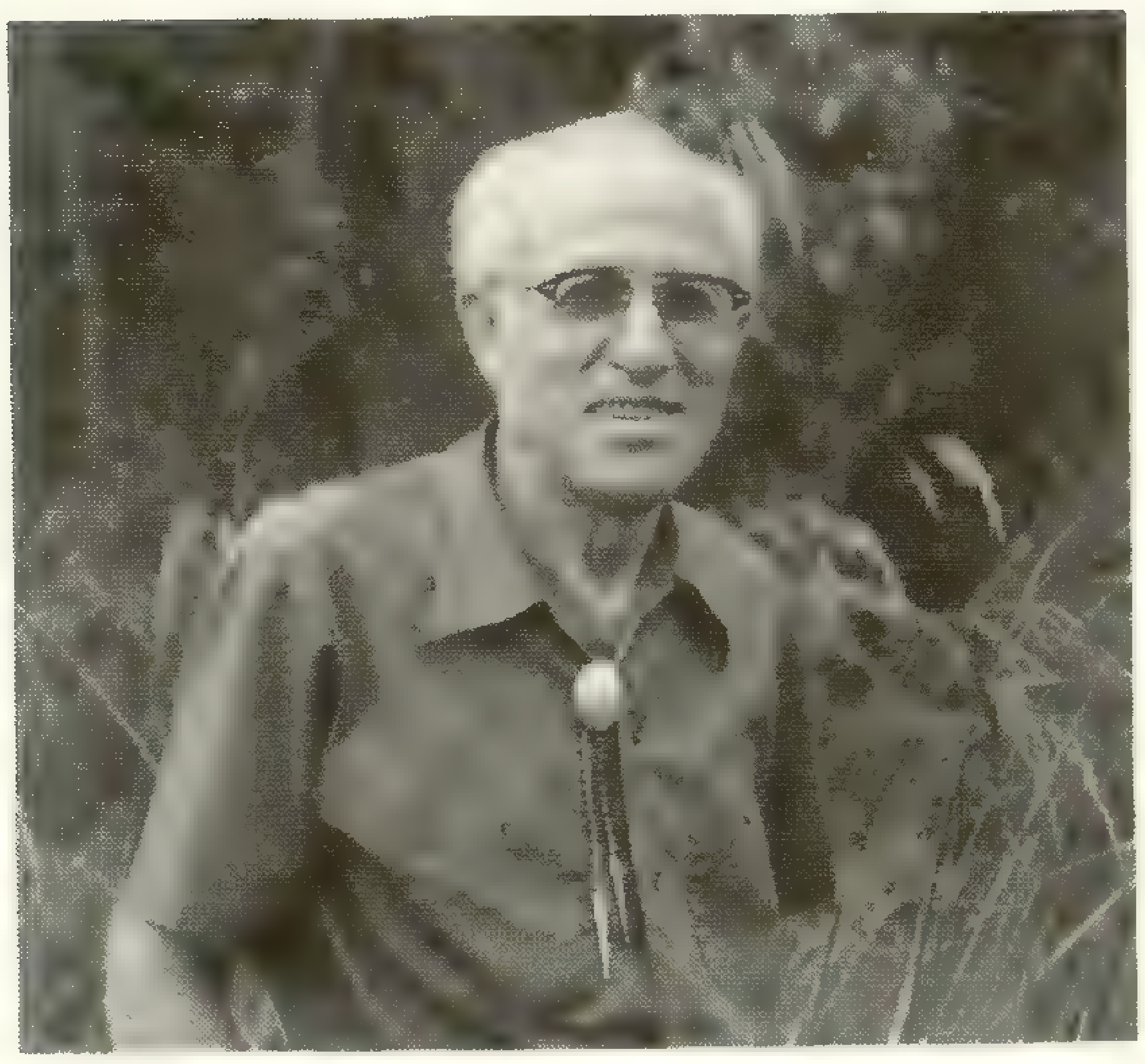
Bartonia No. 53: 47–48, 1987

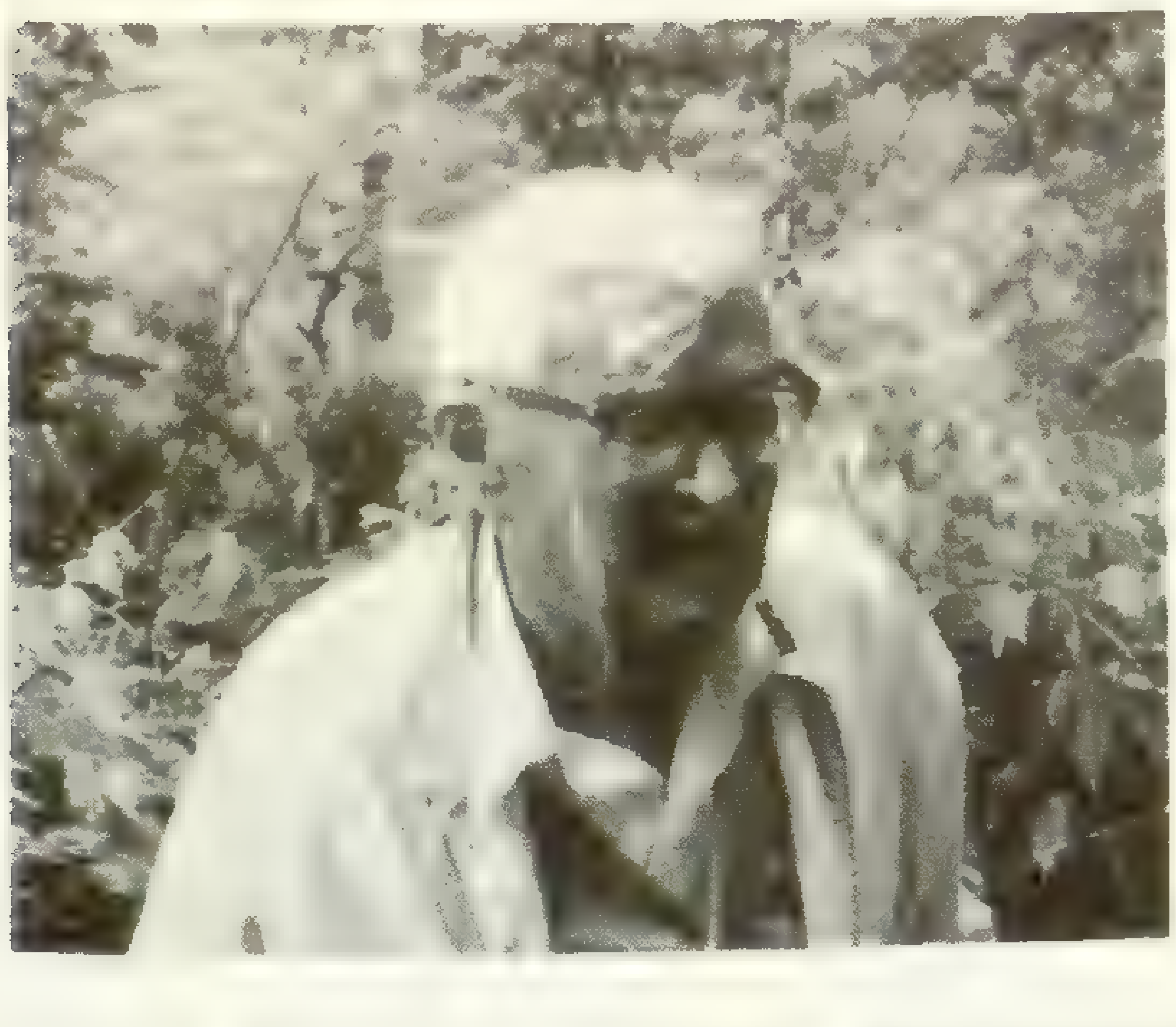
OBITUARIES



Leonard Hay Sweetman (23 March 1912–8 October 1986). Born in Las Animas, Colorado, Leonard Sweetman graduated with a degree in entomology from Colorado State University in 1933, following which he operated a nursery and a farm in his home town. After his wife died in 1960, he moved east with his five children to work for the Veterans Administration Medical Center in Coatesville as head of grounds maintenance. In 1968 he moved to Swarthmore College as assistant director of the Scott Foundation, which maintains the campus as an arboretum. His book, *Carbochon Gems Today*, was published in 1971. In 1974, Leonard was selected to become the first Director of the Elisabeth Phillipe Jenkins Arboretum in Berwyn, Chester County, which position he retained until his retirement on October 1, 1986. As director of a new arboretum, he created a "local paradise" with perhaps the most outstanding collection of Ericacae (rhododendrons and azaleas, primarily) in the Philadelphia area, with a 250 species collection of labeled wildflowers, a poisonous plant collection for use by the students of the University of Pennsylvania veterinary school, and a daylily collection "to extend the blooming period" at the Arboretum. All of these collections were born from the energy and enthusiasm of a true plant lover. ("Home is where the garden is.") The stewardship of the Jenkins Arboretum has now passed to the capable hands of his son, Dr. Harold E. Sweetman, a new member of the Philadelphia Botanical Club.

Leonard was looking forward to a long and busy retirement, volunteering at the Jenkins, doing lapidary work in the basement, planting another "batch" of daylilies at home, and pursuing his interest in photography, when he became the sudden victim of a severe stroke and lapsed into a coma from which he did not recover; he did not suffer. Since Leonard was such a physically and intellectually active individual, we are consoled that Nature determined the best possible ending to a long and fulfilling lifetime.

He is survived by his second wife, Grace Cooper Sweetman, 1712 Fisherville Road, Coatesville, Pa., three sons, Lawrence, William, and Harold, two daughters, Patricia Langley, and Kathleen Standhartdt, four grandchildren, and one great grandchild. ANN E. NEWBOLD



Joseph William Adams (2 March 1906–22 October 1986). Joseph Adams, a long time member of the Philadelphia Botanical Club was born in 1906 in Indian Territory (now Oklahoma). In 1925, while a Jessup Student at the Philadelphia Academy of Natural Sciences, he met Dr. Edgar T. Wherry who was to become a dominant influence in his life. During an association that lasted over half a century, Joe accompanied Dr. Wherry on numerous trips throughout Pennsylvania, New Jersey, Maryland, Delaware, and Virginia to collect ferns and native flowering plants. He participated with Drs. John M. Fogg and Wherry in collections for the *Atlas of the Flora of Pennsylvania* which was published by the Morris Arboretum of the University of Pennsylvania in 1979.

Joe was affiliated with the Morris Arboretum from its founding in 1932 until he retired in 1984. Under Dr. Fogg he held the position of Assistant in Taxonomy and later Curator of the Herbarium. From 1971 until 1984 he served as Curatorial Assistant two days per week while spending many more volunteer hours collecting seeds for the International Seed Exchange.

An inveterate field botanist and collector, Joe had several pet projects in the area of botany and horticulture. He collected and propagated hardy varieties of seedless grapes in collaboration with researchers at the Experiment Station at Geneva, NY. He also sought, without much success unfortunately, a hardy, large-fruited persimmon that could be grown in the Philadelphia area. The American Chestnut, which Joe saw reduced from a dominant forest tree to a few remnant sprouts due to the ravages of Chestnut Blight, was a source of inspiration. Until his death Joe continued to search for potential resistant trees.

With Dr. Wherry, Joe was a founder of the Bowmans Hill Wildflower Preserve in Bucks County, PA. His interest in native wildflowers and ferns was also evident at a "camp" he and his wife Myrtle established near New Bloomfield in Perry County. Nearby was Pennsylvania's largest stand of box huckleberry (*Gaylussacia brachycera*), long a source of interest to Joe and Dr. Wherry, and now protected in a State Forest Natural Area.

Joe's contribution to knowledge of the Pennsylvania flora is evident in the number of herbarium specimens bearing his name in the Academy of Natural Sciences Herbarium. In addition to his collecting and conservation activities, Joe inspired many students of botany by assisting them in recognizing the fine points of grass taxonomy, or introducing them to some of his favorite field haunts. His death marks the end of a generation of amateur and professional field botanists active in the Philadelphia area since the turn of the century. ANN F. RHOADS

Bartonia No. 53: 49–60, 1987

REVIEWS

Developmental Biology of Higher Fungi, by D. Moore, L. A. Casselton, D. A. Wood, and J. Frankland. Cambridge University Press, Cambridge. 1985. xii + 615 pp. $99.50.

Here is a fine reference for anyone needing to know what is going on in the field of research on fungi. It is a report of the Symposium of the British Mycological Society. This big volume contains a great deal of information, most of it about agarics. There are 27 chapters written by experts in their respective fields. Most authors are from the United Kingdom, some are from the United States, and a few are from the Netherlands. All chapters are in English. They are uniformly well written and well documented, with extensive bibliographies.

Each chapter aims to bring the reader up-to-date in the area of the authors' special expertise. The general pattern is a survey of the literature, often followed by a detailed report on the authors' current research, then a discussion and interpretation of what has been discovered and what needs to be investigated further for a more complete understanding. There are many original illustrations and, again, they are of fine quality.

What topics will you find discussed in this book? Food relationships, morphology, ultrastructure, growth, genetics, biochemistry, plus the applied fields of mushroom breeding, commercial production, and composting. Hundreds of fungi are considered in one or more of these contexts. Genera which are discussed at length include *Agaricus, Armillaria, Coprinus, Crinipellis, Flammulina, Lentinus,* and *Schizopphyllum.*

Many aspects of growth are dealt with, beginning with ecological relationships. For instance, Rayner discusses the wide range of food sources used by northern agarics. After reviewing an enormous amount of data, he concludes that food source selectivity, or lack of it, is one of several correlations that tend to confirm the correctness of modern divisions of previously accepted genera. In another chapter, Hedger gives a detailed account of the fungi colonizing Cocoa litter and a summary of what is known about the food relationships of many other tropical agarics. He points out that, in the tropics, obligate ectomycorrhizal fungi are rare, whereas pathogens and saprophytes are numerous and widespread.

The relationship between host cells and invading hyphae is reviewed by several authors who emphasize physiology and by others who emphasize structure. A number of fine electron micrographs show details of host cells, invading hyphae, and interfaces.

One study of the normal early growth of vegetative hyphae calls attention to the change in growth pattern which is required for the production of cords and fans. The straight hyphal tip, which has been producing right-angled branches, has to switch to producing branches to narrow angles. Apparently such a change can be brought about sometimes by external nutrients, or other chemicals, and sometimes by internal factors alone.

There are reports on the early and late developmental stages of several agarics, another on gill development, with an attempt to correlate the growth of gills with enzyme activity, a study of dolipore-parenthesome septa, plus a variety of other topics.

All in all, this excellent book can be recommended to everyone working with fungi, as well as to other scientists who want to know more about mushroom growth and development. EMILY T. WOLFF

Scuppernong, North Carolina's Grape and Its Wines, by Clarence Gohdes. Duke University Press, Durham. 1982. 115 pp. $14.95.

This book is a botanical historian's and oenologist's delight. Written by Clarence Gohdes (James B. Duke Professor Emeritus of American Literature), it is a masterful blend of personalities, politics, and history of the development of the first important native wine grape of the U.S. The Scuppernong grape is a white-skinned muscadine named in 1811 in honor of a swamp section in Tyrrell County, North Carolina. The author meticulously weaves the story of how it was domesticated, who did it, and how it became so popular by 1840 that the federal census declared North Carolina as the chief wine-producing state of the Union. After the Civil War ended slavery, the grape was planted throughout the South with the hope of restoring prosperity through minimum labor. When commercial vintners exhausted the supply of muscadines, they turned to a blend called "Virginia Dare" which they flavored with the scuppernong. This eventually became America's most popular wine. The book is divided into eight chapters including, the early history of the grape, wines, and vines in the Old North State, the Garretts, Prohibition, Wine Concentrates and "Home Manufacture," Post-Repeal, Recent Effervescence, and the Scuppernong and the Plant Breeders. Each section is masterfully written in a scholar's style with numerous well referenced footnotes and interspersed with historical portraits and line drawings of main characters and places as well as maps and a chart of the Dixie grape varietal pedigrees. The source notes for each chapter at the end of the text run to seven pages and are exhaustive and detailed. It is obvious that this is an important reference to those who are interested in all aspects of the economic botanical history of just one native american grape which rose to importance as a commercial product. I found it fascinating reading.
ARA DER MARDEROSIAN

Medicinal Plants in Tropical Africa, by Bep Oliver-Bever. Cambridge University Press, Cambridge. 1986. 375 pp. $75.00.

The massive effects of modernization and the growth of human population brings to bear unprecedented pressures against the flora of the tropics and local knowledge of the value and uses of many plant species. In coming years as deforestation and overexploitation continue, the raw material of ethnobotany will disappear; and as younger generations forsake traditional ways of life, so will the slowly accumulated folk knowledge of wild plants and their uses. Recognition of this accelerating depreciation of natural and human resources is stimulating botanists, ethnobotanists, anthropologists, and others to conserve as much as possible at this late stage of both vegetation and lore. The value of these resources is increasingly acknowledged by scientists. The present book is a valuable attempt to record traditional medical knowledge from West Africa and to place it, together with botanical, geographical, chemical, and medical data, in an integrated context suitable for reference. The author produced an earlier work (1960) in which she described plants and medical uses in Nigeria. The new work is an expanded and updated version. It includes botanical, pharmacological, chemical, and some clinical data relating to drugs, uses, and effects. After introductory remarks discussing the origins of the book, there is a short background exposition of early traditional medicines, and a brief account of practical therapeutic indications and mechanism of action of the drugs. The author groups the plants and their drugs under six categories with reference to their site or mode of action. The first group, treated in Chapter 2, consists of plants whose constituents have an effect on the cardiovascular system, including cardiotonics, cardiac depressants, and vascular agents. In Chapter 3, the site is the nervous system, and stimulants, depressants, and substances with cholinergic and adrenergic actions are grouped together. Chapter 4 deals with anti-infective materials, including antibiotics (grouped under antibacterial, antifungal, antiviral, antiprotozoal, and antimetazoal, the latter chiefly anthelminthic, headings), insecticides, and molluscicides. Plants which affect hormone secretion or which have a hormone-like activity are dealt with in Chapter 5, while sex and thyroid hormones form the basis for Chapter 6. Oral hypoglycaemic activity is discussed in Chapter 7, which includes seven subcategories, the last being sweetening agents. References are grouped by Chapter, but assembled at the end of the book. There is a comprehensive botanical index and a general index.

There are 388 species of plants mentioned in the book (not counting the synonymous names). The nomenclature, taxonomy, spelling, and hierarchical classification are all very well done, following Hutchinson and Dalziel's "Flora of West Tropical Africa" (to which the reader is referred for plant descriptions, which are not repeated in Oliver-Bever's book). For each species, the scientific name (with synonyms where appropriate), indigenous status (non-native species are indicated by the symbol "c"), botanical family, vernacular name in English and three paragraphs, headed "L" for local usage, "C" for chemistry, and "P" for pharmacology, are provided. There are some illustrations, chiefly black and white wash drawings of certain plant species, but some line drawings, including one showing the molecular structure of holarrhenine and 5B-pregnane. The reference section is lengthy, comprising pages 269 to 354. The index is integrated ("Botanical and General Index"), headed by species name, with common name, family, and page reference numbers in an extended tabular format. It is encouraging to find that the book was evidently carefully proofed and there are very few typographic or spelling errors (Marantaceae is spelled Maranthaceae on p. 266, but there appear to be very few such lapses; "Ternstroemaceae" on p. 51).

There are several Tables (not individually identified in the Contents), these being: Tab. 2.1, Apocynaceae in tropical West Africa; 2.2, Asclepiadaceae and Periplocaceae (formerly part of the Asclepiadaceae) in tropical West Africa; 3.1, More important constituents and divergency of pharmacology of West African Menispermaceae species; 3.2, More important constituents and divergency of pharmacology of West African Rubiaceae species with an action on the nervous system; 3.3, Plants with stimulant action on the nervous system which are described in Chapter 2; 3.4, Plants with depressant action on the ANS and CNS which are described in Chapter 2; 3.5, Plants with local anesthetic action which are described in Chapter 2; 4.1, Antibacterial plants; 4.2, Antifungal plants; 4.3, Antiviral plants; 4.4, Antiprotozoal plants; 4.5, Antimetazoal plants; 4.6, Insecticidal and molluscicidal plants; 5.1, Additional anti-inflammatory plants; 6.1, Plants with anti-fertility action in females; 6.2, Plants with anti-fertility action in males; 7.1, Plants containing hypoglycaemic phytosterin glycosides; 7.2, Plants containing hypoglycaemic alkaloids or amino acids; 7.3, Plants containing hypoglycaemic organic sulphur compounds; 7.4, Hypoglycaemic plants containing anthocyanins, catechols or flavonoids, or their glycosides and/or tannins; 7.5, Hypoglycaemic plants containing other active constituents.

This work is predominantly a digest of a quite extensive literature. The level of pharmacological data is impressive; on the other hand, the existence of data is the reason for its inclusion. This is not a manual for application, however; it seems to qualify best to check on the likely effects of use of particular plants, to obtain scientific names when only the English common name is known, to serve as an introduction and entry into the pharmacological and pharmacognostic literature, to review in a brief and convenient format the results of experiments (usually on animals) and thus to suggest potential new experiments or retesting, and to amalgamate in condensed form a very wide and scattered set of research papers. The author quotes three of her own publications; original work however forms a very small component of the contents of the book.

Potential users of the book would include botanists, ethnobotanists, anthropologists, phytochemists, pharmacologists, and physicians wishing to learn more about natural plant drug resources. Relative to the number of species in the West African flora, the 388 species mentioned here is a fairly small number, indicative both of how much is known and how much more is yet to be known.

No ecological, habitat or even broad vegetation zone data is included; the user of the book must have at the ready one or more floristic treatments, starting with the Hutchinson and Dalziel flora mentioned above. No detailed clinical procedures are given; no folk "recipies" or modern equivalents thereof are provided either. Consequently this work is encyclopedic-descriptive, bridging one of the gaps between field ethnobotany and medical practice, but was clearly intended to be used in conjunction with other literature and, probably, with the collaboration of one or more individuals. As a source of important (and often fascinating) information, the book is bound to be very useful, but those who do use it will find that botanical, ethnological, and medical information must also be available simultaneously if it is to serve directly in an applied purpose. The illustrations are decorative and on occasion could be useful, but this is not a herbal and no reliance should be placed on these figures for critical use (no scale is given in any of the figures).

The hard-cover binding is attractive and sturdy, the paper is of good quality, and the printing is excellent, with clear, moderately diverse typography.

There are no vernacular names with plants (or diseases or symptoms) in any of the African languages, which seems a curious and unfortunate omission. While dependency on such names is not to be recommended, the convenience of knowing them may be great, especially when corroborative data is at hand. No doubt in many cases such names are not readily available, and in other cases there may be too many names, but their total absence here means still heavier reliance on supplementary literature or on local informants.

To sum up, this is a useful and scholarly compendium, long on pharmacology and chemistry, short on botany and clinical data, helping to bridge the somewhat remote specialties involved but at the same time dependent on them and their publications, serving to focus attention on a deserving subject. BENJAMIN C. STONE

The Living Tundra, by Yu. I. Chernov, translated from *Zhizn' Tundry* (1980) by Doris Löve. Cambridge University Press, Cambridge. 1984. xiii + 213 pp. $49.50.

Synoptic understanding of arctic ecosystems is often impeded by linguistic barriers where English or Russian is used exclusively in scientific literature. Thus, integrated reviews in Russian are often marginally accessible at best, save for careful translations such as those provided by the Polar Institute. In her translation of Chernov's *Zhizn' Tundry* (1980), Doris Löve has, in addition to a fluid translation, elucidated some problems of terminology and nomenclature, distinguishing at the outset her ideas from those of the author. The result is a thorough review of Eurasian studies of tundra ecosystems. It draws the reader into an appreciation of the interaction of climate, substrate, flora, and fauna despite initial awkwardness in transliterated place names (*os-*

trov for island, *polostrov* for peninsula and *zemlya* for land). However, Russian often provides additional images of tundra landscapes (e.g. *pyatnistaya tundra*, spotted tundra). There is also a thorough discourse on pingo formation. Dr. Löve has added Scandinavian terms for wetlands to offset the limitations of Russian and English terms. The combination of Chernov's understanding of Eurasian ecosystems and Dr. Löve's experience in Scandinavia and North America provides an eloquent discourse on tundra—its diversity and the factors that mold it.

Although the topics treated by Chernov often echo studies of the North American and Scandinavian tundra, particularly in the discussions of abiotic and biotic factors, his primary contributions lies in observations of interactions and distributions of plants and animals (including cryptogamic plants and invertebrates as well as vascular plants and vertebrate animals). Where necessary, he corrects misconceptions about assumed interactions based upon his own extensive observations.

Chernov's discussion of the Eurasian arctic tundra provides an entry into the extensive Soviet literature concerning arctic ecosystems (Aleksandrova 1977), biogeography (Takhtadzhyan 1978; Tugarinov 1928), and palaeoecological concepts such as "tundra-steppe" (Yurtsev 1974) important to understanding the history of North American and Eurasian biota. The bibliography provides a general summary of Russian arctic studies, but unfortunately refers to only one North American study (Washburn 1958). Those familiar with the North American and Scandinavian literature on tundra ecosystems will realize that many seminal works had not found their way into Russian translation by 1980, since references to more recent studies from the North American and Scandinavian Arctic lack complete citations.

Chernov's account of the arctic ecosystem and his committment to its preservation is of interest to both the naturalist with a cursory acquaintance with the biome and to those who study it in depth. Further elegant translations will make Russian scientific literature accessible to those of us with less facility in that language.

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G. CHRISTINE MANVILLE

Poisonous Plants of Pennsylvania, by Robert J. Hill (botanist) and Donna Folland (illustrator). Pennsylvania Department of Agriculture, Harrisburg. 1986. 175 pp. $5.75.

This booklet covers the poisonous plants of Pennsylvania and is the result of a cooperative program between the Pennsylvania State University and the Pennsylvania Department of Agriculture. The author states that the volume is intended for use by homeowners, farmers, veterinarians, and health care professionals as well as botanically curious individuals. The plants are listed in alphabetical form by scientific name using a monographic format. This includes the plant name, family, phenology (flowering time in relation to climate), distribution, plant characteristics, poisonous parts, symptoms, poisonous principles, confused taxa, and species of animals affected and treatment. Generally each plant is presented as an accurately drawn line drawing on one page, with the data above on the facing page. Over 91 plants are covered in this style. A four page glossary of botanical and pharmacological terms is given along with four pages, one each devoted to an appendix on treatments, an appendix on poisonous and edible status of berries and fruits, and nine major references. The index is complete and cross referenced as to both Latin and English names for the plants. The inner front cover lists six state poison control centers in Pennsylvania (curiously omitting Philadelphia?), while the outer inside cover provides a metric and English system ruler and conversion factors for English and metric units.

I found the book to be excellent as for as the illustrations are concerned and good as far as the basic data provided in the monograph is concerned. The data on symptoms, poisonous principles, and treatment were lacking in much detail, probably because of space limitations and audience intended to be served as well as complexity of poisoning managements in some cases. I did feel frustrated by lack of more detail in these areas, particularly where it was obvious that space was available. Some coverages left one-third to half a page blank.

I assume that the reference will be most valuable to homeowners and farmers since there are more extensively written texts available to veterinarians and health care professionals. ARA DER MARDEROSIAN

The Evolutionary Ecology of Ant-Plant Mutualisms, by Andrew J. Beattie. Cambridge University Press, Cambridge. 1985. 182 pp. $24.95.

Andrew J. Beattie has written an excellent review of our current understanding of the diverse and sometimes subtle mutualisms between ants and plants. Although recorded in the scientific literature for 200 years, it has not been until the last twenty years that ant-plant mutualisms have been experimentally studied. A pivotal study by Janzen of the University of Pennsylvania which exposed the obligate mutualism between *Acacia* species and the ant genus *Pseudomyrmex* in Latin America helped initiate the great interest in these interactions that exists today. In his review, Beattie cites studies from temperate, tropical, and desert habitats throughout the world.

The book is organized into nine chapters which cover the known categories of ant-plant mutualisms: (1) plant protection by direct ant defense, (2) plant protection by indirect ant defense, a three-way interaction involving honeydew secreting Homopterans (tree hoppers, leaf hoppers, aphids, mealy bugs), (3) plant nutrient enrichment by associated ant colonies (myrmecotrophy), a mutualism currently restricted to tropical epiphytes and their ant colonies, (4) propagule dispersal by ants, and (5) ant pollination.

The rewards to ants are often more obvious than the rewards to plants. The most basic ant rewards being a place to live (domatia), and food, offered by several plant structures such as elaiosomes, extrafloral nectaries, and food bodies. Elaiosomes are external structures on propagules which stimulate ants to carry them back to the nest. The elaiosome (which is often rich in lipids as well as carbohydrates and proteins) is consumed and the seed is left unharmed, later germinating in the ant nest.

Readers of *Bartonia* will be interested to note that at least 35% of the herbaceous flora of the forests of the eastern United States are ant dispersed. Beattie presents data from a study on ant dispersal of *Sanguinaria canadensis* and how the mutualism begins to break down with increased disturbance in the forest.

Ants exhibit a remarkable number of strategies in defending their plant hosts from threats as diverse as vines, lepidoptera, and large mammals. The distribution of one secondary forest tropical tree is actually dictated by the ability of ants to remove competing vines from the tree.

The role of ants as plant pollinators is the most poorly understood and probably the least important of all ant-plant mutualisms. Widespread ant pollination has not evolved largely because chemicals secreted by ants have been shown to reduce pollen viability. This effect on pollen appears to be incidential to the main purpose of these chemicals which have antibacterial and antifungal properties.

Each chapter is concluded with a very helpful concise summary. However, the chapter on the origins and early evolution of ant-plant mutualisms was the least clear. The supporting data in each chapter is presented in well organized tables, while the line drawings are illustrative but somewhat mechanical. As would be expected, the reference section is extensive.

The central lesson of this book is that "major gains in fittness accrue to plants mutualistic with ants," but that these mutualisms are most often facultative and not obligatory. Although a scholarly volume and part of the "Cambridge Studies in Ecology" series, the fascinating examples Beattie uses to substantiate his ideas make for interesting reading for both the ecologist and amateur naturalist. SARA E. DAVISON

The European Garden Flora, Vol. 1. Pteridophytes to Monocotyledons, edited by S. M. Walters, A. Brady, C. Brickell, J. Cullen, P. S. Green, J. Lewis, V. H. Matthews, D. A. Webb, P. F. Yeo, and J. C. M. Alexander. Cambridge University Press, Cambridge. 1986. xv + 430 pp. $99.50.

Although numbered as vol. 1, this is in fact the second in the series to be published. The coverage deals with several orders of Monocotyledonae, from Alismatales to Iridales, the Gymnospermae, and the Pteridophytes. A glossary and an index are provided. The book is large, just over 8½ × 11 inches (22 × 28 cm), hardbound with an orange and blue cloth cover, and well printed in clear type. The illustrations are all in black and white, many (of the ferns) being frond silhouettes all in a gray, rather than black, impression. The figures are seldom of whole plants but depict more usually special features of importance in identifying the species.

The main aim of the flora, of course, is to provide a single source for the identification of as many as possible of the plants frequently cultivated (outdoors) in Europe. The nomenclature is scientific (vernacular names are seldom given, but "fancy" cultivar names are occasionally provided). There are brief descriptions, keys, and brief notes of horticultural interest, plus a certain amount of reference citation to other useful works. Infraspecific taxa, such as botanical (not horticultural) varieties, subspecies, and also hybrids, are for the most part omitted. Wild source (distribution) is given. An indication of "hardiness" is given for the use of gardeners.

Production of a work of this type is to some extent an unenviable task. Criticisms of what is omitted, what is included, and the amount of text or emphasis will vary widely from reader to reader. Indeed, identifying the principal audience is not so easy. The rather austere appearance of the work, chiefly due to its "scientific" format and the absence of bright colored illustrations, may frighten away some who actually would find the work useful. Those willing to use scientific terminology and understand technical nomenclature will benefit from the work. Nonetheless there is much more likelihood that this work will reside in libraries for reference, rather than in private homes.

It is evidently not for the rank, or even the moderately advanced, amateur. Other criticisms might center on the need for such a broad geographical scope (its applicability in the easternmost and southernmost parts of Europe may fall off). Maintaining a file on what species are really ''common'' in cultivation is no easy task; there may be a tendency then to add species to an encyclopedic coverage which are ephemeral or remain so rare as to be virtually unknown. The task of each author and of the editors to adjudicate such matters is often very difficult. Questions of omission are equally delicate. One of the most difficult problems is the matter of horticultural names, many of which are in Latin but are not necessarily acceptable under the International Code of Botanical Nomenclature; others are outdated in botanical use (often by many decades or even centuries) but persist in popular literature. Some represent major misidentifications. The chance of missing a ''commercial'' name, which nonetheless is widely used, may be greater than missing a scientifically well-known synonym. The fact is, there is a chasm separating much horticultural and technical botanical literature and in its flows that sometimes impassable stream, nomenclature. The flora by and large comes down on the side of precise, scientifically based nomenclature (and classification) and that is good; but in the process seems to have shut out the amateurs whose sincere interest may prove inadequate to the enjoyable use of the volume. How may one solve this problem? It seems to be of long standing, and, perhaps, permanent. Presumably only the passage of time and some feedback from the community of botanists and gardeners who use such a work as this can really instruct us on how useful it is, how well it is received, and whether or not such a work was properly conceived in the first place. One must admire and congratulate the editors and the various contributors for their knowledge, enthusiasm, and willingness to share both, while remaining somewhat uncertain as to the outcome of the effort.

The impression remaining after examining the work is that it will be used by botanists; will be worthwhile for libraries to obtain for their reference collections; will be consulted on occasion by amateurs, who will in many cases need help and/or further references; will help us to know what plants are in cultivation somewhere in Europe; but will not inspire much amateur activity. One does not wish to seem ungrateful, yet one's response to this work is somewhat bemused. Speaking as a botanist, this reviewer tends to find the volume on the whole worthwhile; I would like to know, however, what a knowledgeable, active gardener, with amateur status in scientific botany, thinks. Such a reader might well say: ''Thanks; I'll have a look at the Library copy later.'' BENJAMIN C. STONE

An Introduction to Plant Cell Development, by Jeremy Burgess. Cambridge University Press, Cambridge. 1985. viii + 246 pp. $19.95 (paper).

It was with some enthusiasm that I undertook to review *An Introduction to Plant Cell Development*. Textbooks dealing in detail with plant development are relatively rare and those specifically concerned with the plant cell are essentially absent. There is therefore a major deficit at a time when the understanding of the special nature of the plant cell is critical to environmentally-sane industrial exploitation of plant resources.

The study of development of any organism is a blend of anatomical and physiological understanding placed within a chronological framework. Someone undertaking such a task is required to have a clear understanding of these two fields. Unfortunately, the present text is deficient in both areas. Even aspects related specifically to the cellular level of organization are covered in much greater detail in most standard texts of plant physiology, such as Salisbury and Ross (1985) or even the older Bidwell (1979) and the details presented on cellular structure are much surpassed by the classic text of Esau (1977). While it might be argued that these texts are more restricted in scope, and so more capable of providing a greater depth of detail, a greatly expanded and more thorough treatment in the present book could have provided a basis for the type of thought and insight urged by the author.

A case in point is the treatment of phytochrome and its relationship to photomorphogenesis. The explanation of the possible mechanisms of action of this pigment system are much oversimplified and there is no mention of much of the recent work which relates to the forms of the pigment, locations in the cell, or effects on cellular activities rather than those of the whole plant. The coverage of lignin and the role of the cell wall in development was likewise deserving of better treatment.

Another shortcoming of the book is the limited potential as a sourcebook of easily-identified references. While the author hopes "to stimulate the reader to a greater curiosity" none of the data or conclusions presented are referenced to specific primary research or major reviews. The curious reader is left with a section titled "Further Reading" in which it is not clear whether the sources serve primarily as background, a list of fundamental or critical research papers, or a guide to related, but ancillary, areas.

Undoubtedly, the strongest and most interesting portion of the book is that relating to polarity and positional effects in plant systems. This is admittedly the author's primary area of focus and the treatment here reflects that interest. These topics, covered in chapters 6 and 7, are just beginning to be appreciated in plant biology and have application in both whole plant and tissue culture studies. I cannot recommend this book as a text for a course in plant development or plant cell biology, but perhaps as supplemental reading for physiology or anatomy courses for its coverage in these relatively new areas.

As in so many other publications in science, the word "regime" was used when "regimen" was intended. On the whole, however, the editing of the book was good, and only in one place did an error cause a difficulty in understanding. I suspect that students lacking a background in physiology and anatomy would fail to grasp many of the implications of the material presented, but those with such a background would find this book inferior in its coverage.

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JOHN R. PORTER

That Magnificent Cestrian, by Dorothy I. Lansing. Serpentine Press, Paoli. 1985. xi + 87 pp. $14.95 (paper).

William Darlington (1782–1863) left the family farm (and the Quaker assembly, too) to become a physician, naval surgeon, congressman, banker, botanist, and most prominent citizen of West Chester, PA. In *That Magnificent Cestrian,* Dr. William Darlington, Dorothy Lansing has summarized in an eighty-seven page booklet the life and accomplishments of William Darlington.

It is in the field of botany that Dr. Darlington is now best known beyond the boundaries of Chester County. Darlington was a correspondent and contributor to Asa Gray of Harvard, John Torrey of Columbia University, of Daniel Drake in Ohio, and various European scientists. Darlington's own rich herbarium is at West Chester University, and he contributed significantly to the herbaria of the Academy of Natural Sciences, the Westtown School, Swarthmore College, and the George School.

His botanical activities stemmed from the extraordinary teacher and inspirer of botanists, Benjamin Smith Barton of Philadelphia. His botanical career was capped with the three editions of the *Flora Cestrica* (the first called *Florula Cestrica*) in 1826, 1837, and 1853.

There are some errors in the spelling of Latin terms and the conventions of capitalization of botanical terms. But the misspellings and questionable uses are a very small and fairly unimportant part of Dr. Lansing's work. All in all, this work is well presented and very enjoyable to a person interested in the history of science, the history of Pennsylvania, the history of medicine, and, indeed, the story of a man who stood a head above the rest. JAMES A. MEARS

The Botany of Mangroves, by P. B. Tomlinson. Cambridge University Press, Cambridge. 1986. xii + 413 pp. $69.50.

Barry Tomlinson, already author or editor of several books basically on structural, morphological or anatomical themes, has now gathered another of his long-standing areas of research, mangrove botany, into a monograph which, with some reservations, will surely join the ranks of such standard works as those of Schimper (1891), MacNae (1968), Walsh (1974) and Chapman (1976). It provides the field with the consolidated, functionally-oriented account it long has lacked as well as the only modern "mangrove flora of the world." For many readers, it will also introduce the diverse mangroves of the Asia-west Pacific tropics, an assemblage much richer than found in the mangals of the Americas or western Africa.

With two basic aims, *The Botany of Mangroves* is appropriately organized in two sections. Section A, comprising 44.5% of the body of the work, is a "General Account," with nine chapters respectively treating ecology, floristics, biogeography, shoot systems, root systems, water relations and salt balance, flowering, seedlings and seeds, and utilization and exploitation. Section B, disguised under the title "Detailed description by family" and making up the remaining 55.5% of the work, is a conventionally organized systematic treatment, with keys to all taxa and references to standard literature, of 117 mangrove and associated tracheophyte species in 36 families and 64 genera, of which Tomlinson treats 59 as "true mangroves" (no consistent limitation has been generally accepted, and many workers are now inclined to accept that there are "degrees of mangroveness"). The book concludes with a consolidated list of references and an index; there is no glossary.

Tomlinson's basic concern is for mangroves as individuals, and for these uses the term "mangrove," "mangal" being reserved for the *ecosystem*—a distinction first proposed by MacNae (1968). This is reflected elsewhere in the book by generally careful attention to morphological concepts and terminology. The book reads comfortably, although for some a botanical dictionary will be a necessity, and is copiously illustrated with tables, graphs, photographs, and many botanical drawings (notably those by Priscilla Fawcett).

The Botany of Mangroves is just that: a botanical book. Animal life, in its own right a large and imperfectly known area of study, is not much accounted for save in the treatments of the biological relations of individual species, nor is there much emphasis on ecological and vegetatiological aspects, now relatively well if haphazardly and unevenly treated in many other works. The author has chosen, quite properly I believe, to focus on the considerable corpus of research and publication in mangrove botany, both classical and recent, giving him also a chance to reflect on that not inconsiderable portion which has issued from his own circle over a period of close to twenty years, particularly in chapters 4–8 which represent the structural and biological essence of mangroves as plants and again in the systematic treatment of *Rhizophora*.

There are many flashes of sensibility and humor in the book, and the last chapter of section A closes on page 170 with a moving parable about the woodcutter and his small boat. All this serves to bring alive a biome which until rather recently was very imperfectly understood and suffered a "bad press."

Many interesting suggestions are made, and some will surely provoke discussion. I like particularly the call in chapter 1 for greater awareness of mangroves as individuals in the ecosystem, as well as the idea that mangroves are at once "pioneer" and "mature" species. On the other hand, with a work by a single author there is an inevitable tendency to rely on "authorities" in areas outside one's particular competence without at times being fully aware that differing or contrasting interpretations of particular phenomena or processes exist.

Some minor points are singled out for comment here. In Section A are interspersed keys to genera of "strict mangroves" (pp. 38–39), leaf anatomy (pp. 93–95), and pollen (pp. 143–144). I feel these could better have been incorporated in an appendix. The paper by Barth (1982) on which much of the first part of chapter 3 is based is unfortunately cited only in serial form and not also as part of a monograph. Chapter 4 omits mention of a key review of functional morphology by Peter Saenger as the collection of which it is part (Clough 1982) has not been cited. Finally, I would like to have seen an historical chapter; *how* we reached our present understanding of mangroves may to some be just as interesting as merely summarizing *what* we know, or wish to know, about them.

No taxonomic account can ever be perfect; plants, people, and knowledge are dynamic. Tomlinson has made by far the best recent effort to draw together the widely scattered systematic literature on mangrove species and provide basic descriptive details, keys, and literature references. His intent, however, is principally to provide a "biological flora" of mangroves, and the species accounts emphasize where possible autecological and biological observations of the kind usually absent from conventional floras and related works. It is only too clear, however, how little remains known of some species. Not only is this a problem of remoteness but also with countries which for one reason or another do not, or not now, place a high value on basic research. In many cases we remain dependent upon knowledge gathered in periods, often long ago, wherein more such interest was being shown.

The main criticism that I would make of the systematic treatment is that species delimitation is based almost exclusively on standard published revisions and monographs which in many cases do not reflect our most recent possible taxonomic thinking. I feel that for each family or genus the choice of treatment should be justified, and some indication given of current research should such be in progress. This would also help to give taxonomy a "positive" feeling.

This book is the first in a new series of what is claimed on the back of the dust jacket to be an effort to present the many advances in tropical biology of recent decades, both theoretical and empirical, in a manner "suitable for advanced students of biology and nonspecialists." Tomlinson's book is a worthy start, although to me it may not be easy for the nonspecialist and, I suspect, even for some students of biology whose grasp of basic botany may not be satisfactory. As a major new contribution to the field, it is strongly recommended for all botanical and biological libraries concerned with organisms as well as larger public libraries, as well as individuals active in mangrove research. Unfortunately, the price may be too high for some, especially in countries or states where the subject matter makes it appropriate or even essential.

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DAVID G. FRODIN

Bartonia No. 53: 61–65, 1987

NEWS AND NOTES

FIRST RECORD OF VITTARIA GAMETOPHYTES IN EASTERN MARYLAND. I discovered *Vittaria* gametophytes at Deer Creek State Park in Harford County while exploring outcrops of metaconglomerate-metagraywacke at the site with my colleague Kenneth Miller. This is the first reported station for *Vittaria* in this county. A voucher is at MVSC.

Deer Creek, a third order stream, flows from north to south through a narrow gap in Rock Ridge. The steeply sloped ridge is comprised of a very limited metaconglomerate lithofaces within the Wissahickon formation (D. Southwick and G. Fisher, 1967, Maryland Geological Report #6). The ridge is forested primarily by *Quercus rubra, Q. prinus,* and *Betula lenta*. The gametophytes are scattered in shaded northwest facing rock crevices of a 20–25 meter high cliff.

Allison Cusick has just reported the first occurrence of *Vittaria* gametophytes in Maryland (Castanea 51:129, 1986). His Garrett County site is in the Appalachian Mountains of extreme Western Maryland, in the center of *Vittaria's* known range, and about 300 km from the Harford County station. Farrar, Parks, and McAlpin (Rhodora 85:83, 1983) included Lancaster and York County stations near the Susquehanna River in their report of *Vittaria* in Pennsylvania. These sites, about 50 km northeast, are closest to the Harford County, Maryland, locality. They are in crevices of Wissahickon mica schist near shaded second order streams flowing into the lower Susquehanna River. Of the 20 stations I have located in Pennsylvania, these are the only two not on sandstone. The less suitable substrate may be compensated by a more equitable microclimate in the deep ravines near the river. The Harford County, Maryland, site is the only one I have located in the piedmont away from the Susquehanna. Here, the seemingly less equitable microclimate may be compensated by the arenaceous substrate. The apparent disjunct distribution of *Vittaria* in Maryland is only partially due to incomplete field research on this minute, cryptic fern. Because suitable habitat is so uncommon, I suspect that the presence of *Vittaria* gametophytes in the piedmont of northeastern Maryland will prove to be quite rare. Also, as these prothallia do not give rise to a spore producing phase, their mode of dispersal and presence at widely scattered sites remains enigmatic. JAMES C. PARKS

PROTECTION FOR BRISTOL MARSH. A new nature preserve has been established by the Eastern Pennsylvania Chapter of The Nature Conservancy to protect one of the few remaining intertidal marshes along the Delaware River. The marsh just to the south of the Borough of Bristol in Bucks County supports such rare intertidal plants as *Amaranthus cannabinus, Bidens bidentoides, Echinochloa walteri, Sagittaria calycina* var. *spongiosa, Sagittaria subulata, Scirpus smithii,* and *Zizania aquatica*. To ensure the protection of the marsh, the Conservancy has signed a long term management lease with the borough and has received a conservation easement from Rohm & Haas Company. In the coming year, an observation platform will be constructed to facilitate visitation. S. E. DAVISON

BENNETT BOGS UPDATE. Long-time readers of Bartonia will remember articles from the 50's (Bartonia 28:36–37) and early 60's (Bartonia 33:12–13) on the establishment of the Bennett Bogs Nature Sanctuary in Cape May County, New Jersey. In the last two years The Nature Conservancy has joined forces with the New Jersey Audubon Society to enhance the protection of this ecologically unique Sanctuary. Nineteen additional acres have been acquired bringing the total acreage up to 25, and a preserve committee has been initiated. The Sanctuary is an assemblage of coastal plain intermittent ponds which support rare flora, mostly of southern affinities. Just a few of the plants of interest include: *Boltonia asteroides, Eleocharis melanocarpa, Eryngium aquaticum, Gentiana autumnalis, Manisurus rugosa, Muhlenbergia torreyana,* and *Sclerolepis uniflora.* S. E. DAVISON

EASTERN PENNSYLVANIA RARE PLANT SURVEY 1986 HIGHLIGHTS. 1986 was a productive year for the Morris Arboretum Rare Plant Survey. With funding from the Wild Resources Conservation Fund, the survey team, consisting of Ann Rhoads, Richard Mellon, and Ann Newbold, made several notable discoveries.

The highlight of the year was easily the rediscovery of a thriving population of *Polemonium van-bruntiae* Britt. in Wayne County, PA. Last visited by Edgar Wherry in 1938, this site had proved elusive despite several efforts to relocate it. The Morris Arboretum team used a topographic map annotated by Dr. Wherry to find the plants in a complex of several hundred acres of wetlands.

Prior the this discovery it was feared that *Polemonium van-bruntiae* had been extirpated in Pennsylvania. The species has a limited range which extends from West Virginia north to Vermont and Quebec. It was at one time being considered for federal listing under the Endangered Species Act but has been dropped back to inactive C3 status due to the presence of 18 known stations in New York State.

Elsewhere, in addition to the Pennsylvania station, there are 2 sites in Maryland, 6 in West Virginia, 7 in Vermont and 2 known locations in Quebec. The plant has not been seen recently at 3 other historical sites in Pennsylvania. *P. van-bruntiae* will be classified as Endangered on the Pennsylvnaia Plants of Special Concern list.

The discovery of a previously unreported site for *Carex polymorpha* Vahl in Luzerne County was another high point of the season.

Classified as Endangered in the state, *Carex polymorpha* is a federal candidate species undergoing active consideration for listing under the Endangered Species Act. It is known from 3 Pennsylvania locations, 2 in Maine, 1 in New Jersey, and 3 each in Virginia and West Virginia. There is a good chance that this plant will be added to the federal list within the next year or so.

The newly discovered stand is on State Game Lands in an area where the Pennsylvania Department of Environmental Resources has proposed to construct a dam. In addition to the *Carex polymorpha* colony, the site contains a large population of *Lygodium palmatum* (Bernh.) Sw. which is classified as Rare in Pennsylvania. The site is currently underoing a thorough environmental assessment to evaluate the impact of the proposed dam.

Arethusa bulbosa L. had not been reported in northeastern Pennsylvania since 1939 when it was rediscovered at a bog in northern Wayne County on June 3, 1986. A hard frost on the night of June 1 destroyed a number of blooms but several survived unscathed. Further exploration of the area is scheduled for June 1987 when it is hoped additional plants will be found.

Over the years the Morris Arboretum team has searched numerous historical locations for *Helianthemum bicknellii* Fern. without success. However, a July visit to the Chrome Barrens in Chester County finally proved fruitful. A small colony of *H. bicknellii* was found on the edge of cleared area in this serpentine barrens near Oxford, PA.

This elusive species has been reported from approximately 40 Pennsylvania sites from the northeast to several southcentral counties. However, searches of many of the reported locations have failed to turn up any sign of the plant. The reason for its apparent decline is not known.

Amelanchier bartramiana (Tausch) Roemer, another plant feared lost from the state, was rediscovered in a dense shrubby bog in Monroe County growing with *Ledum groenlandicum* and *Nemopanthus mucronata*.

Ann Robinson of Carnegie Mellon University, who is studying the Pennsylvania Amelanchiers had reported rescuing the last plant of *A. bartramiana* she could find from in front of a bulldozer which was clearing land for construction of vacation homes several years ago. Dr. Robinson accompanied the Arboretum team on the successful search for additional wild populations of this shrub with its distinctive pear-shaped fruits. A more complete assessment of the population at this site will be made in the spring of 1987 when the blooming plants should be easier to spot.

Complete reports on these and other rare plant populations inventoried in 1986 have been submitted to the Pennsylvania Natural Diversity Inventory. Herbarium specimens have been deposited in the Herbarium of the Morris Arboretum. ANN F. RHOADS

IS PINE BARREN STREAM ECOLOGY THREATENED? Nowhere else have we found the spectacular combinations of underwater plants contained in the tea-colored streams of the New Jersey Pine Barrens. We have canoed streams from Quebec to Florida, from West Virginia to the western states and this lush combination of plants we have found nowhere else.

Canoes ride on top of the water, having little effect on the plants growing under the water, but a new sport, tubing, could eventually destroy all these plants and the entire ecology of the stream.

The Delaware River, being wider, deeper, and frequently with a rocky bottom is not vulnerable to people riding down river in inner tubes. This is not so for the streams of the Pines that are narrow, with undulating shallow bottoms of sand and muck.

One of the most beautiful of the underwater plants is the water club rush (*Scirpus subterminalis*), sometimes called "drowning mermaid's hair," its long green hair-like leaves twisting and turning in the underwater currents among occasional protruding stiff stems which hold the minute flowers above water for pollination. Another plant, frequently growing underwater mixed with the water club rush, is the bayonet rush (*Juncus militaris*) with its smooth round stem—red underwater, bright green above. Also there are the bur-reeds (*Sparganium*), pipeworts (*Eriocaulon*), pondweeds (*Potamogeton*), and manna grasses (*Glyceria*).

It is strange to a non-botanist that many of these plants growing in the water assume different shapes than the same plant growing out of the water, particularly being elongated, sometimes many times the length of same plant growing in wet area.

As we canoe along, we enjoy the plants whose flowers peak their heads above the water, pickerel weed, water lilies, iris, golden club, bladderworts, and water shield. In one backwater, we find hundreds of pitcher plants floating in the water, unconnected with the ground beneath.

Botany books and nursery catalogues report that *Ilex glabra*, the pine barren holly, grows to four feet. They never measured this plant growing along the banks of streams of the Pine Barrens where they are frequently ten to 14 feet tall.

I understand some commercial enterprises in the Pines are stocking up on tubes for rental, a frightening development foretelling the distruction of the rare and beautiful aquatic plants, which flourish in the shallower sections of the stream bed where tubists must carry their tubes and walk.

Can tubers be restricted to certain rivers? How can we mitigate this onslaught? Can the aquatic plantlife of the Pines be saved? JOSEPH M. VOLK

EASTERN PENNSYLVANIA NATURAL DIVERSITY INVENTORY 1986 VEGETATION SURVEY HIGHLIGHTS. The Pennsylvania Natural Diversity Inventory (PNDI) is a systematic and ongoing survey to collect and store, in a centralized data management system, information on Pennsylvania's rare and endangered flora and fauna. The program is a joint effort of the Pennsylvania Department of Environmental Resources, The Nature Conservancy, and the Western Pennsylvania Conservancy, with cooperation from the Morris Arboretum of the University of Pennsylvania. The PNDI staff has collected and processed information on 5,677 rare plant, animal, and exemplary natural community element occurrences (sites). At the close of the 1986 field season the PNDI, through its contractors, collaborators, and staff, had documented an estimated 1,000 occurrences of Pennsylvania's rare flora and fauna. Seven of the more significant plant finds made by the Eastern office of the Inventory in 1986 are discussed below.

Poa paludigena is found in spring fed swamps and algific talus slopes in Minnesota (1 site), Michigan (1 site), Indiana (6 sites), and Pennsylvania (4 sites). It is reported as historic or extirpated in Wisconsin, Illinois, Ohio, and New York. It is currently listed as endangered in Pennsylvania and being considered for federal listing. In June 1986 I found Pennsylvania's fourth known extant population in Carbon County. It is growing along an intermittent stream, in a series of small seeps with *Chrysosplenium americanum, Cardamine pennsylvanica, Senecio aureus,* and *Veratrum viride.*

Cryptogramma stelleri occurs on cool, damp, calcareous, shaded rocks and ledges. It is circumboreal in distribution and rare throughout northern New England; Maine (5 or fewer sites), New Hampshire (5 or fewer sites), and New Jersey (considered extirpated). The species is currently listed as endangered in Pennsylvania. In July of 1986 Anthony Wilkinson and I found the third extant site for this species in Pennsylvania. It was growing in small numbers on a moist, shaded, calcareous shale ravine wall with *Asplenium rhizophyllum* in northern Lycoming County.

Juncus militaris is a plant of acidic shallow waters. It is currently listed as endangered in Pennsylvania, considered historic or extripated in Delaware, Indiana, Maryland, and Vermont, and is known from 10 or fewer sites in Michigan. In August of 1986 A. E. Schuyler and I confirmed the second extant Pennsylvania site for this plant. It was growing in small numbers in a shallow water zone with *Scirpus torreyi,* also listed as endangered in Pennsylvania, on the edge of a large lake in Luzerne County.

Glyceria obtusa, a northern grass of acid wetlands, is listed as endangered in Pennsylvania, and known from five or fewer sites in Maryland and Ohio. I confirmed the third known extant population of this species in Pennsylvania in September of 1986. It was growing in abundance on the edge of a disturbed acid peatland with *Carex rostrata, Juncus canadensis,* and *Spiraea tomentosa* in Monroe County.

Iris verna, a southern species of xeric sandy uplands, was relocated in Cumberland County in a large Pitch Pine-Scrub Oak Barren Community. This is the second known extant locality for this state threatened species. It is also known from five or fewer sites in Maryland and Ohio.

Juncus torreyi is a species of calcareous seeps in Pennsylvania. It is listed as threatened in Pennsylvania, known from five or fewer sites in New Jersey and Vermont, and considered historic or extripated in Maryland and West Virginia. In August of 1986 A. E. Schuyler and I found the third known Pennsylvania population near an abandoned slate quarry in Lehigh County.

An aerial survey of a southern Lancaster County serpentine barren revealed numerous open glade areas throughout the barren. In surveying these areas I found *Sporobolus heterolepis,* a Pennsylvania endangered grass not previously reported from the site, and *Talinium teretifolium,* a Pennsylvania threatened species not seen at the site since 1937. The following previously reported species of special concern were also found, *Aster depauperatus, Fimbristylis annua, Scleria pauciflora,* and *Senecio anonymus.*

The Pennsylvania Natural Diversity Inventory is funded by The Wild Resource Conservation Fund, The Nature Conservancy, and the Western Pennsylvania Conservancy. We invite the participation and correspondence of those interested in the Inventory. If interested, contact T. Smith, Pennsylvania Natural Diversity Inventory, The Nature Conservancy, 34 Airport Drive, Middletown, Pennsylvania 17057. THOMAS L. SMITH

ALEXANDER WILSON MEMORIAL COMMITTEE TO RESTORE GRAVESITE. Alexander Wilson, the "Father of American Ornithology," was an important figure in Philadelphia's golden age of natural history, living and working here until his death in 1813. He was a friend of many prominent botanists, including John and William Bartram and a member of the American Philosophical Society. His gravesite, at Gloria Dei "Old Swede's" Church in Queen Village, still exists but has fallen into disrepair after years of neglect. A number of natural history, Scottish, and scientific organizations have organized an effort to honor Wilson by restoring and landscaping this gravesite. A financial goal of $10,000 has been set for the work, and contributions (made payable to the Scottish Historical and Research Society, "Wilson Fund") may be sent to David Lauer, 607 E. Thompson St., Philadelphia, 19125. DAVID LAUER

Bartonia No. 53: 66–71, 1987

1986 FIELD TRIPS

April 19: Big Elk Creek, Chester County, PA. This was a joint trip of the Philadelphia Botanical Club and the Delaware Valley Fern Society. Some 120 species of plants were recorded from the gravel road between the creek and the hillside. The creek lowland and the hillside lend themselves to further study since the whole area cannot be adequately surveyed from the road. Ferns included *Athyrium angustum* and *Polypodium virginianum;* shrubs included *Kalmia, Rhododendron,* and *Lindera* with many wildflowers in between them. Leaders: Dutch Huttleson and Charlotte Shaefer.

April 26: Smedley Park, Media, Delaware County, PA. We visited the two best stations for *Viola rotundifolia* and *Epigea repens* in Delaware County and both species were in full bloom. The group saw an excellent spring flora in this creek valley park. Unfortunately, the future status of both *Viola rotundifolia* and *Epigea repens* are in doubt. The "Blue Route," a four lane highway is expected to cut directly through the area where they are found. Plant rescue teams of DVCS Inc. are scheduled to transplant stocks to an appropriate location if required. Leader: Jim McGrath.

April 27: Lebanon State Forest, Burlington County, NJ. Within sight of the firetower, we observed mature plantations of such non-native species of the Pine Barrens as *Pinus resinosa, P. stobus,* and *P. taeda* and evaluated their success on pine barrens sites. Also seen were *Pinus sylvestris, Larix decidua, Castanea mollissima,* and *Ulmus pumila.* But a large roadside patch of flowering *Pyxidanthera barbulata* received most of the attention.

Students under the direction of Antoni Dammam of the University of Connecticut at Storrs joined us to see *Helonias bullata,* which we encountered in the Shinn Branch watershed. A half dozen were associated with *Sphagnum flavicomans, S. nemoreum,* and *S. magellanicum.* In the adjacent pitch pine lowland, we examined buds of *Xerophyllum asphodeloides, Leiophyllum buxifolium,* and *Aronia arbutifolia.* In the uplands, *Arctostaphylos uva-ursi* made a fine display. At McDonald's Branch watershed, *Schizaea pusilla* and *Smilax laurifolia* were the main attraction.

After a short stop at a sphagnum moss gather's camp at Woodmansie, we proceeded to Bullock to see *Viola pedata* var. *peariloba.* Also in flower was a bit of *Epigea repens.* At North Branch, *Orontium aquaticum* and *Chamaedaphne calyculata* brightened the cedar bog. Nearby along the Glassworks Road we marvelled at a giant *Chamaecyparis thyoides* (7 ft, 11.5 in CBH) that has miraculously escaped the axe. Everyone recorded a lifetime plant upon seeing a single specimen of the endangered *Uvularia pudica* var. *nitida* (Pine Barrens Bellwort) in anthesis in the Whitesbog outlier. Except for our final stop a couple miles east of New Lisbon for the endangered *Lygodium palmatum,* our botanizing was confined to Lebanon Forest and its periphery. Leader: Ted Gordon.

May 10: Bowman's Hill Wildflower Preserve, New Hope, Bucks County, PA. Most of the early blooming spring wildflowers, e.g. bloodroot, Dutchman's breeches, trout lily, and trailing arbutus were passed their blooming period, but a good number of later-blooming plants were observed. Among these in fine flowering condition were: *Stylophorum diphyllum, Anemone quinquefolia, Aquilegia canadensis, Geranium maculatum, Arabis laevigata, Polemonium reptans, Stellaria pubera, Dodecatheon* *meadia, Chrysogonum virginicum, Cypripedium calceolus, Trillium erectum, Trillium grandiflorum, Viola striata, Zizia aurea, Cardamine bulbosa,* Silene virginica, *Polygala pauciflora, Hydrastis canadensis, Senecio aureus, Podophyllum peltatum,* and *Cypripedium acaule.* Leader: Bob Meyer.

May 11: Watchung Mountains, Somerset County, NJ. Our first stop was the flood plain forest along the North Branch of the Raritan River at Burnt Mills to observe the extensive carpets of *Mertensia virginica.* Other plants of interest found were *Floerkea proserpinacoides, Arisaema dracontium, Lilium canadense,* and an escaped or planted stand of *Monarda didyma.* We next explored the trap rock woods, glades, and meadows along a small stream in the first Watchung Mountain near Bound Brook. In the dry woods we saw *Taenidia integerrima, Orobanche uniflora, Scirpus verecundus,* and several species of violets (*Viola palmata, V. Sororia, V. pubescens, V. fimbriatula, V. sagittata,* and *V. rostrata*). Also located was a large population of *Dentaria heterophylla* which reaches its northwestern most limit of its range in New Jersey's Watchungs. In the open glades and on the exposed rock ledges occurred several uncommon New Jersey species: *Geum virginianum, Ranunculus micranthus,* and *Oenothera tetragona.* Seen here, too, was the very rare and at this date, very immature, *Scutellaria leonardii.* Finally, in a moist stream side meadow we found *Selaginella apoda,* basal rosettes of *Liatris spicata, Pedicularis canadensis,* and a few plants of *Castilleja coccinea.* We were all distressed by the damage done to this meadow by the numerous crisscrossing trails made by dirt bikes. While the *Castilleja* came only within a few feet of being destroyed, a small colony of *Scutellaria leonardii* fared less well and has gone to that great herbarium in the sky. On the up-side, the New Jersey Natural Heritage Program has identified this area of the Watchungs as having one of the finest assemblages of trap rock flora in the state and is one of some forty other areas of concern now being considered for protection efforts through the New Jersey Critical Areas Program of the Nature Conservancy's PA/NJ Field Office. Leader: David Snyder.

May 28: Batsto and Pleasant Mills, Burlington and Atlantic counties, NJ. A morning session around lawns and roadsides turned up over a hundred species of plants, including coastal plain specialties like *Euphorbia ipecacuanhae, Minuartia caroliniana, Opuntia humifusa, Hudsonia ericoides,* and *Plantago aristata.* After lunch, an excursion in the old "Batsto Nature Area" added *Quercus stellata, Quercus marilandica, Schizaea pusilla, Leiophyllum buxifolium,* three species of *Drosera,* and many species of heaths typical of the Pine Barrens. *Mirabilis nyctaginea* was found in bloom on the road shoulder near Pleasant Mills Church. The lichens *Cladina submitis, Cladonia subtenuis, Cladonia uncialis, Parmeliopsis placorodia,* and *Lecidea uliginosa* were noted in passing. Leader: Karl Anderson.

June 8: Craven Estate, Salford Township, Montgomery County, PA. First we visited the lichen-covered field of diabase ringing rocks known as "The Potato Patch"—an area south of the terminal moraine but close enough to experience periglacial climatic effects which, in freezing and thawing, heaved up a field of stone "potatoes." *Corydalis sempervirens* and *Polypodium virginianum* were in crevices at the edges. Across the dirt road was the "Wild Flower Field" which contained *Krigia biflora, Chamaelirium luteum, Lobelia spicata, Pycnanthemum tenuifolium,* and *P. virginianum, Cas-*

tilleja coccinea, Lilium canadense (not quite in bloom), *Phlox maculata,* and *Oenothera tetragona,* surrounded by shrubs and trees such as *Ceonothus americana, Xanthoxylum americanum, Ilex verticillata, Cephalanthus occidentlis, Dirca palustris,* and those two "iron woods" side by side, *Carpinus caroliniana* and *Ostrya virginiana* with *Waldsteinia fragarioides* beneath them. The best part (depending on the viewpoint) was counting 25 different carices and 13 different ferns, and getting lost in search of "Indians Alleys." This 105 acre property is now up for sale, as its caretaker-owner recently died. Hopefully the Berks County Conservancy can obtain it. Leader: Ann Newbold.

June 14: Upper Perkiomen Park, Green Lane, Montgomery County, PA. Trip participants provided the following list of species: *Actaea pachypoda, Asclepias quadrifolia, Asclepias purpurascens, Aristolohia serpentaria, Zizia aptera* and *Z. aurea, Hieracium venosum, Smilax herbacea, Galium boreale, Prunus virginiana, Pyrola elliptica, Lobelia spicata, Ceanothus americana, Oenothera tetragona, Stellaria graminea,* and *Physocarpus opulifolius.* Leader: Mariana McCabe.

June 15–18: Paul Smiths, NY. The 1986 Joint Field Meeting of the Northeastern Section–Botanical Society of America, The Philadelphia Botanical Club, and the Torrey Botanical Club convened from June 15 to the 18th at Paul Smith's College, Paul Smiths, NY. Michael Kudish of Paul Smith's College briefed the group on Adirondack geology and soils and led tours of the bogs and forests on the extensive Paul Smith's preserve. Edwin Ketchledge spoke on the high forests, alpine flora, and acid rain problems followed by a tour of the forests and alpine areas on Whiteface Mountain. Dr. Ketchledge also led a study hike up Mt. Algonquin to observe the flora and the success of his alpine revegetation project. Alfred E. Schuyler spoke on aquatic vegetation and led study trips on Lower St. Regis Lake adjacent to the Paul Smith's campus. Mildred Faust led tours around Heart Lake while others hiked up nearby Mt. Jo. Other sites visited included a rich fern, lichen, and moss area in Wilmington Notch along the West Ausable River, and a calcite area, rare in the Adirondacks, in Cascade Pass. The meeting concluded with a dinner at which time Karl Anderson announced planning for the 1987 meeting in the Portland, ME, area. The meeting concluded with an entertaining and informative lecture by Dr. Kudish on the early Adirondack railroads and their effect on the forests of the Adirondacks. Accomodations and service provided by Paul Smith's College were excellent and good weather, with few black flies and mosquitoes, made conditions ideal for field work and conviviality. Chairman: Clarence W. Gehris.

July 12: Bear Swamp West, Cumberland County, NJ. We hiked into the heart of Bear Swamp West to sample the floras of two communities, the shores of the freshwater, acidic ponds remaining after cessation of glass-sand mining activities, and the apparently primary broadleaved swamp forest adjoining these ponds. The shores of the ponds are in the early phase of a primary succession and the future stages are hard to predict. The following were seen on these shores: *Sagittaria engelmanniana, Lobelia nuttallii, Carex crinita* var. *crinita, Dulichium arundinaceum, Eleocharis microcarpa, E. tuberculosa, Rhynchospora capitellata, Drosera intermedia* (very abundant), *Myriophyllum humile* (both emersed flowering and submersed forms), *Juncus acuminatus, J. effusus, Utricularia geminiscarpa, U. vulgaris, Lycopodium appressum, L. carolinianum, Decodon verticillatus, Rhexia virginica, Pogonia ophioglossoides* (fruiting),

Polygala nuttallii, Potamogeton confervoides, and *Xyris caroliniana.* The section of (apparently) primary forest visited is, in the writer's opinion, the most beautiful and stately portion of the tract. This section is slightly drier than much of the forest, with little or no standing water present at the time of the visit, although the soil was very moist. Dominant trees are *Nyssa sylvatica, Liquidambar styraciflua,* and *Acer rubrum,* all of which grow very tall. An occasional very large specimen of *Magnolia virginiana* can be found; in fact the highlight of this segment of the trip was undoubtedly the discovery of a wind thrown but still living specimen of this species, which club members carefully measured and found to be 73½ inches in circumference at breast height. The previous state girth record for this species was 62 inches for a living, standing specimen elsewhere in Bear Swamp West. The understory tree and shrub dominants of the forest are *Ilex opaca* and *Clethra alnifolia.* Leader: Stevens Heckscher.

July 26: Roebling Park, Crosswicks Creek, Hamilton Township, Mercer County, NJ. We searched the marsh edge and adjacent floodplain forest in a portion of Roebling Park that will be destroyed by the extension of Route 295. The floodplain forest was dominated by *Acer saccharinum, Fraxinus pennsylvanica,* and *Betula nigra* and supported associated species such as *Vitis riparia, Lysimachia ciliata, Osmorhiza longistylis, Geum laciniatum, Carex rosea,* and *Teucrium canadense.* An upland slope west of the park entrance was dominated by *Fagus grandifolia* and several *Quercus* species. This area also supported *Silene stellata, Aster cordifolius,* and *Solidago caesia.* The final leg of the walk was around Spring Lake where we recorded *Heteranthera reniformis, Peltandra virginica, Potamogeton crispus, Wolffia columbiana, Salix fragilis, Solidago sempervirens, Ceratophyllum demersum,* and *Arthraxon hispidus.* Leader: Joe Arsenault.

August 2: Lebanon State Forest, Burlington County, NJ. This trip included a session devoted to lichen study, and participants were introduced to soredia, isidia, apothecia, podetia, and other lichenological arcana. Twenty-four species of lichens were noted, including *Cladina arbuscula, C. submitis, C. subtenuis, Cladonia atlantica, C. squamosa, C. calycantha,* and *C. floridana;* several species of *Parmelia;* and the ever-popular Tar Lichen, *Lecidea uliginosa.* In addition to lichens, typical Pine Barrens vascular plants were seen, among them *Platanthera blephariglottis, Polygala brevifolia* and *P. lutea, Rhexia virginica, Galactia regularis,* and the grasses *Calamovilfa brevipilis, Amphicarpum purshii,* and *Eragrostis curvula,* and a variety of oaks and heaths. The ericaceous genera *Gaylussacia* and *Vaccinium* were in abundant fruit and of general interest. Leader: Karl Anderson.

August 23: Delhaas Woods, Bristol Township, Bucks County, PA. After checking some of the dominant trees (*Liquidambar styraciflua* and *Quercus phellos*) and shrubs (*Clethra alnifolia*) at the edge of the woods, we concentrated on the flora in the powerline clearing northeast of Delhaas High School. Here we saw *Rhexia mariana* and *virginica, Lysimachia hybrida, Eupatorium pilosum* and *rotundifolium, Bidens polylepis, Polygonum hydropiperoides* and *pensylvanicum,* five species of *Panicum* (*anceps, longifolium, rigidulum, verrucosum,* and *virgatum*), *Andropogon glomeratus, Calamagrostis cinnoides, Chasmanthium laxum, Eleocharis engelmannii, obtusa,* and *tenuis,* and *Rhynchospora capitellata.* Around an old gravel-pit pond, we saw *Gratiola* *aurea* in and out of the water and *Juncus debilis, Lindernia anagallidea,* and *Hypericum mutilum* on the moist shore. *Egeria densa* occurred as a submergent. We did not venture into the wet woods where we could have seen more rare Pennsylvania plants. After lunch on the waterfront in Bristol, we went into the adjacent tidal marsh and concluded the trip after we had seen five species of *Sagittaria* (*calycina, graminea, latifolia, rigida,* and *subulata*). Leader: A. E. Schuyler.

August 24: Intermittent Ponds, Egg Harbor City vicinity, Atlantic County, NJ. In Big Goose Pond, totally devoid of standing water, we searched unsuccessfully for *Eleocharis equisetoides* and *Sagittaria teres.* Our reward came upon finding in anthesis a dozen plants of *Ludwigia linearis,* large clusters of fruiting *Scleria reticularis* var. *reticularis,* dominant stands of sterile *Panicum hemitomon,* and scattered pockets of fruiting *Rhynchospora inundata,* the latter favoring the muckiest zones that were relatively free of competing vegetation. In addition to these species of southern affinities, we examined the cleistogamous nutlets of the unusual grass, *Amphicarpum purshii,* and encountered *Eleocharis robbinsii, Rhynchospora fusca,* thousands of tiny seedlings of both *Cladium mariscoides* and *Lachnanthes tinctoria,* and a showy display of some 100 *Utricularia cornuta.* The center of the pond was scarred by motorcycle tracks. In the adjacent, dessicated Little Goose Pond we found two or three flowering individuals of the endangered *Rhexia aristosa* as well as several plants of the rare *Psilocarya nitens.* An extensive search for *Lobelia boykinii* and *L. canbyi* proved unsuccessful. At Hirst Pond (formerly Labounsky Pond), we enjoyed a breathtaking floral display composed primarily of *Coreopsis rosea, Gratiola aurea,* and *Rhexia virginica. Ludwigia linearis* and *Scleria reticularis* were not uncommon in this lush, colorful meadow blanketing the "pond" bottom. A *Rhexia* exhibiting features of both *R. aristosa* and *R. virginica* was the topic of considerable speculation. A diligent search turned up our most significant find, two flowering specimens of *Lobelia boykinii.* Our final stop was a disturbed site near the old Egg Harbor City dump north of Route 561 to see a fine stand of *Spiranthes tuberosa.* Leader: Ted Gordon.

September 6: Mason Run, Gloucester Township, Camden County, NJ. For an autumn view of this area visited in June 1984, we first searched the old mill pond and the bottom of the dry lake for additions to our original findings. Species of interest included *Lycopus uniflorus, Solidago patula, S. elliottii, S. gigantea, Gentiana andrewsii,* and *Lobelia cardinalis.* After a short break for lunch we traveled to the dry lake bottom of the former commercial Hidden Lake Swimming Club. This location produced an interesting display of *Spiranthes cernua,* many of which reached 40 cm. Also seen at this site were *Spiranthes gracilis, Sabatia angularis, Goodyera pubescens, Anemone virginiana, Euonymus americana,* and *Quercus rubra.* Leader: Joe Arsenault.

September 13: Bowman's Hill Wildflower Preserve, New Hope, Bucks County, PA. Approximately 45 species of plants were observed in flower along with a few late-blooming grasses. Goldenrods proved most abundant, with 13 species being identified. Asters were the next most prevalent group, with 6 species observed in bloom. Along the main road through the refuge, we saw *Elephantopus carolinianus,* a plant with a more southern and mid-western distribution, although listed in the literature as having been found in New Jersey. The flowers were exceptionally attractive to honey bees.

Fourteen species of grasses were identified. The *Solidago* species seen in bloom were: *rugosa, bicolor, gigantea, altissima, nemoralis, speciosa, sempervirens, graminifolia, odora, rigida,* and *patula*. Leader: Bob Meyer.

September 20: Clayton Park, Delaware County, PA. Along the powerline cut that runs through the park, we saw six *Eupatorium* and eight *Solidago* species in or near full bloom, including *E. hyssopifolia, E. pilosum,* and one *E. rotundifolium* and *S. bicolor, graminifolia, nemoralis,* and *tenuifolia*, the last in full bloom. On the banks of the cut grew large colonies of *Lycopodium clavatum, lucidulum, flabelliforme,* and *obscurum*. With the first two clubmosses were small colonies of *Liparis lilifolia* and *Goodyera pubescens. Spirea tomentosa*, just past blooming, and *Bidens polylepis* were common out in the open, together with *Trichostema dichotomum* and scattered plants of *Polygala sanguinea*. In the west end of the park, the following grew in or near a sphagnous ditch: *Aronia arbutifolia, Bartonia virginica, Juncus acuminatus* and *effusus, Rhynchospora capitellata,* and *Spiranthes cernua* (in bud) with *Viola primulifolia*. We crossed two roads at the west end of the park, and observed a stand of *Viburnum cassinoides* along one. On the far side of the roads, where the powerline cut continued beyond the park, we observed the following in a low moist grassy site: *Chelone glabra, Plathanthera lacera, Lyonia ligustrina, Alnus serrulata, Polygala verticillata* and *saguinea, Diospyros virginiana,* and dried-up stalks of *Equisetum sylvaticum*. On and near a dry sterile hillside further west we saw *Asclepias viridiflora, Lespedza capitata, repens,* and *nuttallii,* together with *Diodea teres* in great abundance. On the way back, some members stopped to look at a small colony of *Oxypolis rigidior*. Leader: Jack Holt.

October 18: Upper Bucks County, PA. At a bridge across Beaver Creek on diabasic boulders, *Hedwigia ciliata, Grimmia* cf. *apocarpa, Dermatocarpon fluviatile,* and *Collema* spp. were common together with crustose lichens. At Rapp Creek ford, *Anomodon rostratus, Bartramia pomiformis, Bryum pseudotriquetrum* and various *Lepraria* spp. grew on red shale and argillite cliffs; *Amblystegium fluviatile* was common at water level along Rapp Creek. At Ringing Rock Park, at the base of a moist argillite cliff, *Anomodon attenuatus, A. rostratus, Porella pinnata, Conocephalum conicum,* and *Bryum pseudotriquetrum* were found; on gray argillite above the falls, *Hedwigia ciliata* and *Grimmia apocarpa* were common. The major feature of the park—The "ringing rocks" of diabasic felsenmeer—had *Stereocaulon paschale* and *Lecanora chrysoleuca* along with *Polytrichum longisetum* growing in between boulders and near the base of boulders. Boulders on the oak–maple–beech woods were often covered with *Parmelia plyttii* and various species of crustose lichens. Leaders: Christine Manville and Anna Felton.

Bartonia No. 53: 72–76, 1987

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1986	*Subject*	*Speaker*
23 Jan	Plants of the Beartooth Plateau	James K. McGrath
27 Feb	Fortesque Glades and Bear Swamp	Stevens Heckscher
27 Mar	Poisonous Plants	Ara Der Marderosian
24 Apr	Ferns are Ferntastic	Karl H. Anderson
22 May	Review of 1985–1986 Field Trips	Joseph Arsenault
25 Sept	Member Reports of Summer Botanizing	
23 Oct	Highlights of the Anacardiaceae	John D. Mitchell
20 Nov	Where Four Worlds Meet	Thomas Dolan IV
18 Dec	Peat Mining and the Wetlands of the Pocono Plateau of Pennsylvania	Jane Rowan

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Plants of the Hamilton Marshes: A Delaware River Freshwater Tidal Wetland

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Freshwater tidal wetlands cover an estimated 500,000 to 1,000,000 ha along the Atlantic and Gulf Coast states (Odum, Dunn, and Smith 1979) where they serve as buffers between estuaries and upstream ecosystems (Simpson et al. 1983a). During our studies of plant productivity and vegetation dynamics, beginning in 1974, we observed the diversity of vascular plant species in the Hamilton Marshes (also known locally as the Trenton Marshes), the northernmost freshwater tidal wetland on the Delaware River in New Jersey. The purpose of this paper is to summarize our qualitative and quantitative data on the distribution and abundances of species. We also summarize pertinent geologic and land use information for the wetland complex.

LOCATION, PHYSIOGRAPHY, SEDIMENTS, AND GEOLOGY

The wetland-upland complex occupies an old meander on the alluvial plain of the Delaware River (Fig. 1), and covers ~500 ha of which ~260 ha are palustrine and riverine tidal wetlands (Tiner 1985). It is bounded by bluffs to the east and by the Delaware River to the west. Crosswicks Creek is the major stream in the wetland but there are numerous smaller channels, such as Watson Creek, that wend through it. The dynamic nature of Watson Creek was described by Abbott (1887: 158–159):

> The alluvial flats through which it flows are very uniform in composition; and unless lodged by trees, borne hither and thither by freshlets, have been the cause, there is nothing to show why the creek is not almost a straight line, instead of being as tortuous as a writhing serpent.
>
> That it has changed its course for many a rod, even in historic times, there is evidence in maps attached to old deeds. That it was equally erratic in prehistoric times is also demonstrable, but not with so little labor. In several tracts of the lower lying meadows ancient channels can still be traced, and when ditches have been cut, I have gathered many a curious relic of Indians, left upon what was the bank of a stream, centuries ago.

Sediments are primarily alluvial and aeolian (Wagner, Miller, and Foss 1982; Stewart 1983). Alluvial sediments were deposited from both the Delaware River and Crosswicks Creek. Those from the Delaware River are silts and clays rich in organic matter while sediments from Crosswicks Creek are typically carbonaceous sands with smaller amounts of silt and clay (Owens and Minard 1975). Aeolian sediments were deposited during periods of drought (Wagner, Miller, and Foss 1982; Stewart 1983). Carbon dating of surface sediments show that deposits date from the Pleistocene through Holocene while the deeper sediments are the unconsolidated Cretaceous clays and sands

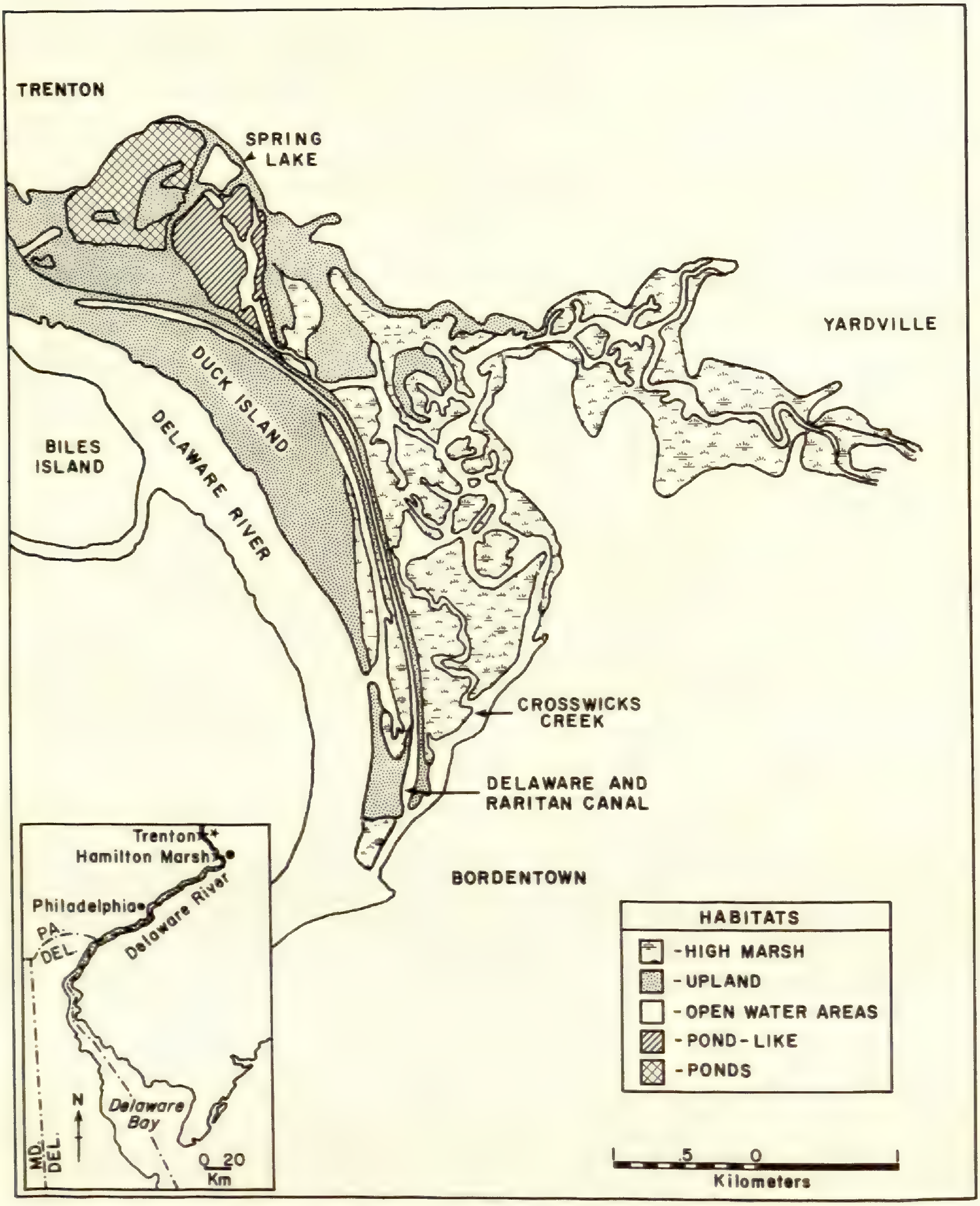

TRENTON
SPRING LAKE
YARDVILLE
DUCK ISLAND
DELAWARE RIVER
BILES ISLAND
CROSSWICKS CREEK
DELAWARE AND RARITAN CANAL
BORDENTOWN
HABITATS
-HIGH MARSH
-UPLAND
-OPEN WATER AREAS
-POND-LIKE
-PONDS
.5 0
Kilometers
Trenton
Hamilton Marsh
Philadelphia
Delaware River
PA.
DEL.
Delaware Bay
N
MD.
DEL.
0 20
Km

FIG. 1. Location of the Hamilton Marshes (inset) and extent of primary vegetation habitats.

of the Raritan Formation. Below these sediments the basement rocks are mostly amphibolites and gneisses (Owens and Minard 1964). Sediments of higher elevation areas within the wetland-upland complex are generally of different origin. For example, Duck Island is composed of superficial deposits that are classified as Graywacke I sediments and are interstratified sand and gravelly sand of Pleistocene origin which may be as young as the Wisconsin Glaciation but more likely as old as the Sangamon (Owens and Minard 1975).

The older and better drained sediments along stream terraces or levees (Wagner, Miller, and Foss 1982), which were probably formed during the last ice age (see Hamblin 1985), are now relatively stable. These areas are currently forested, and have been sites of historic (as shown in aerial photographs) but not prehistoric (K. Kalb pers. comm.) agriculture.

Only in low lying areas is active sedimentation still occurring in response to regional environmental shifts such as the warming and drying that occurred during late Middle and early Late Archaic times (Wagner, Miller, and Foss 1982; Stewart 1983). Accretion rates, measured by Pb210, are currently 0.8 cm yr-1 (Simpson, Good, and Orson unpublished), but were much slower in the past. Most of the surface sediments have high organic matter content related to the high rates of production and subsequent deposition of large amounts of organic matter. The sediments in wetter areas contain 13–36% organic material and have bulk densities of 0.18–0.53 g cm-3 (Sickels and Simpson 1985).

LONG-TERM VEGETATION HISTORY

Vegetation history of the wetland was evaluated from the analysis of sediment cores (Russell 1986; pers. comm.). Sediments from a 6 m core, taken at the base of the Lister site bluff (Fig. 2, site 9), were dated to 8580 ± 100 BP and indicate that a lake, presumably an oxbow lake, was present for a long period of time. The pollen record indicates that plant taxa, now present in the wetland, have been present for thousands of years. Over the millenia, however, various groups waxed and waned in importance depending on climatic conditions.

LAND USE HISTORY

The wetland and adjacent high ground to the east (Fig. 2) have a varied and rich history as suggested by designation as the Abbott Farm National Landmark. The wetland-upland complex was the site of considerable Indian activity. Use by Woodland Indians, especially by Middle Woodland groups (Cavallo 1983), extended to the 18th century. Although the Indians must have used the wetlands extensively, as suggested by Abbott (1887), they probably had little impact on the physical environment as their activities primarily involved fishing and hunting (Cavallo 1983).

In the early 1700's when the wetland was on the edge of civilization and Trenton was known as the Falls of the Delaware, Isaac Watson owned property from the bluffs to the Delaware River (West 1954). Adjacent property, settled by John Abbott, was later the home of Charles C. Abbott (1843–1919), a well known naturalist and archeologist whose writings describe the wetland as he saw it a century ago (Abbott 1887). We have not examined maps from the colonial era to determine what types of physical alterations were effected after settlement by Europeans, but written records indicate that significant changes occurred. Natural drainage patterns were modified as parts of the wetland were diked, drained, and used for agricultural purposes (Wagner, Miller and Foss 1982). In fact, Abbott (1887) refers to "meadow ditches" and "pasture meadows" still being used in the 19th century, and aerial photographs (1930, 1940) indicate that agricultural use extended into the 20th century. These meadows were drier than at the present time (C. C. Abbott photograph ~1910). Destruction of wet-

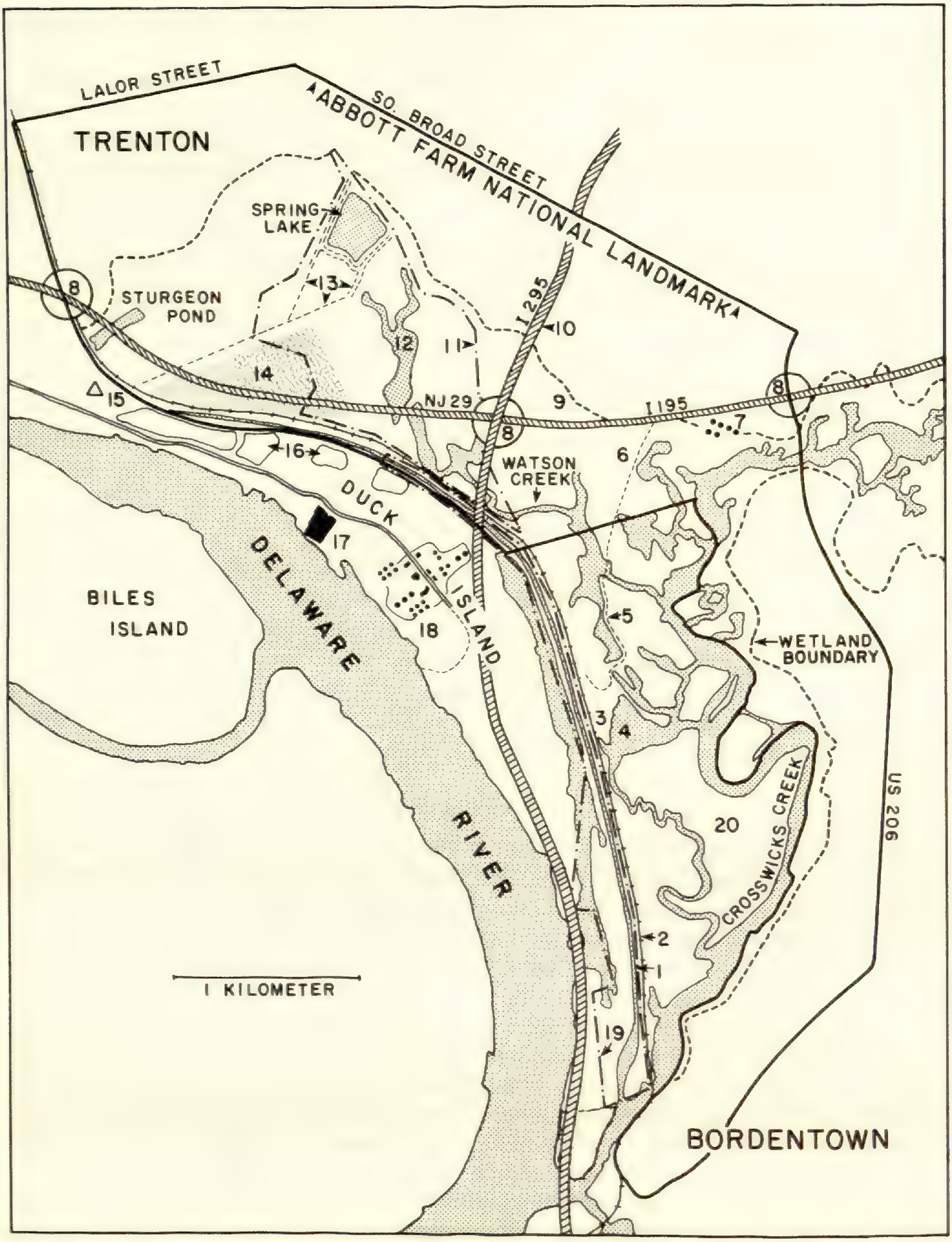

LALOR STREET
SO. BROAD STREET
ABBOTT FARM NATIONAL LANDMARK
TRENTON
SPRING LAKE
13
8
STURGEON POND
I 295
10
12
11
14
15
NJ 29
8
9
I 195
7
8
16
WATSON CREEK
6
DUCK ISLAND
17
DELAWARE RIVER
BILES ISLAND
18
5
WETLAND BOUNDARY
3
4
20
CROSSWICKS CREEK
US 206
2
1
1 KILOMETER
19
BORDENTOWN

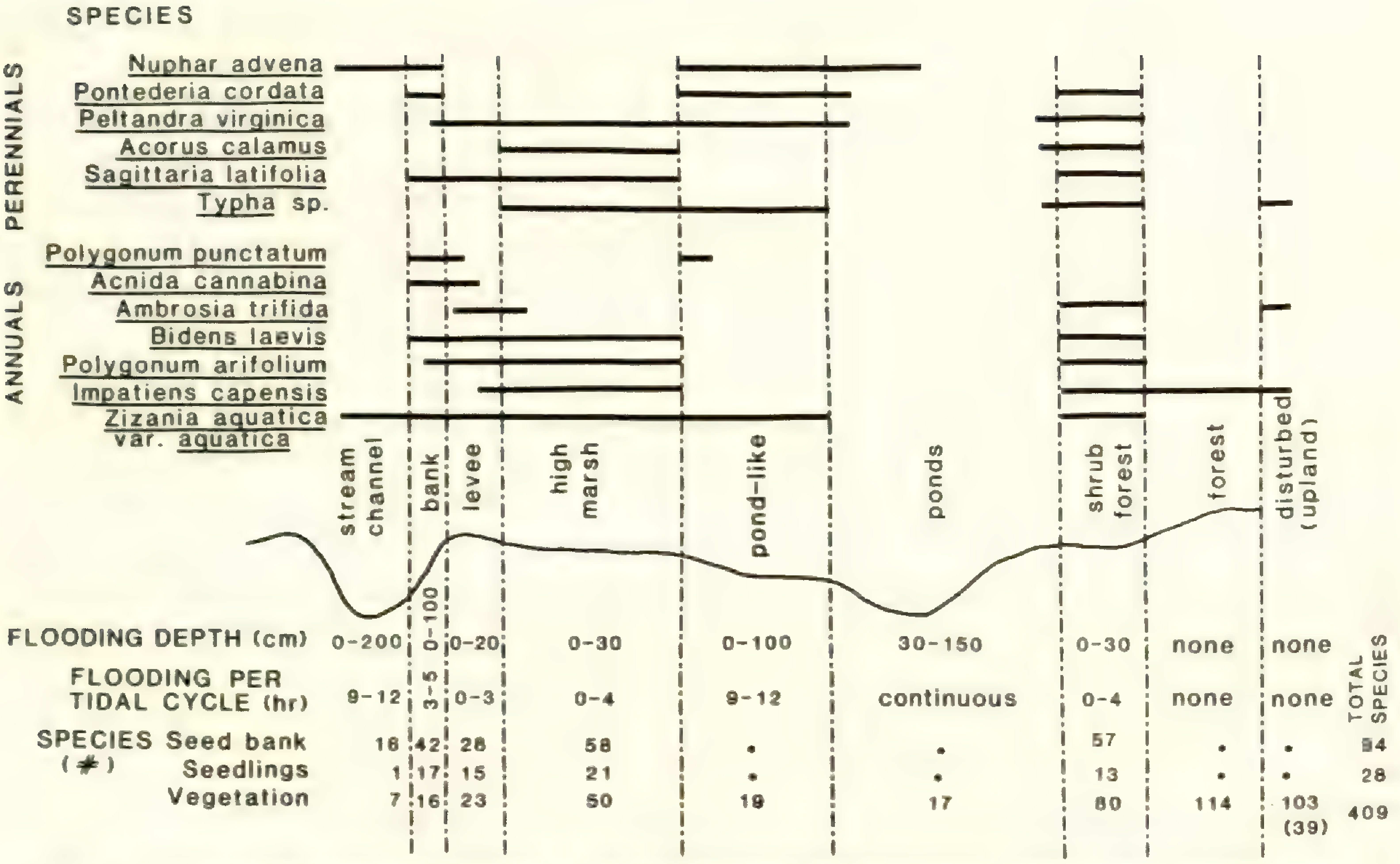
FIG. 2. Anthropogenic landmarks associated with the Hamilton Marshes. (1) Delaware and Raritan Canal, (2) Conrail (Camden and Amboy Railroad), (3) brick factory site, (4) lagoon, (5) road, (6) primary study site, (7) Hamilton Sewage disposal plant, (8) Interchange (highways and interchanges currently under construction), (9) Lister Bluff site, (10) I 195, I 295, and NJ 29, (11) Roebling Memorial Park, Mercer County Park system, (12) Rowan Lake, (13) service roads and high tension wires, (14) landfill, (15) Resource Recovery Plant, (16) Containment lagoons and other artificial landmarks, (17) Public Service Gas and Electric Co., (18) gas and oil tank farm, (19) Delaware and Raritan Canal State Park (entire length of the canal), (20) Duck Island State Recreation Area.

lands along the Delaware River during the past 50 years has caused increased runoff and an associated ~1 m rise in tide level (Sharp 1984).

From 1830–1838 the first large-scale physical alteration in the wetland occurred with construction of the Delaware and Raritan Canal (Fig. 2, site 1). At the same time the Camden and Amboy Railroad (now operated by Conrail) was constructed adjacent to the canal. This construction created Sturgeon Pond and blocked the mouth of Watson Creek, preventing it from flowing directly into the Delaware River and causing it to become a branch of Crosswicks Creek. Duck Island, which had been marsh, was altered by the changed hydrology and later by deposition of hydrofill from Delaware River navigation projects (Heite 1986). The canal and the railroad signaled the beginning of many other changes. A brick factory was built adjacent to the Canal (Fig. 2, site 3). It took advantage of coal, transported via canal, for fueling kilns and the local clay supply. A large shallow open water area adjacent to the brick factory ruins, as well as other ponds through the wetland, may be the result of digging clay for bricks (Davison 1976). Brick manufacture in the Trenton area dates to 1674 (Weiss and Weiss 1966). About 100 yrs ago Spring Lake was created by diking ~7 ha of the wetland. Aquatic grasses were harvested until about 1955 (Schmeltz per. comm.), and a well-known amusement park operated at Spring Lake until the 1940's. Since the 1930's, considerable industrialization has occurred on Duck Island; gas and oil terminals were built in the 1930's and a coal-burning power plant was built in the 1950's. The latter was accompanied by the filling of a corridor through the wetland for transmission lines, which further reduced the flow of tidal water between the areas around Spring Lake and Sturgeon Pond and the adjacent wetland. A large landfill (Fig. 2, site 14), operated between ~1960 and 1976, designated as a hazardous waste site between 1982 and 1985 by the New Jersey Department of Environmental Protection (Remington 1986), caused loss of ~23 ha of wetland. An additional ~40 ha of wetland will be destroyed by the interchange for Interstates 195 and 295 (Fig. 2, site 8), and the proposed mitigation (40 ha) will involve deforesting and excavating part of Duck Island (Remington 1986). Approximately 5 ha were filled in for the Hamilton Township sewage treatment plant and sludge lagoons between 1930 and 1960. Currently the plant adds more than 10,000,000 gal d-1 of secondarily treated wastewater to the wetland. In addition, stormwater drains of both Hamilton and Bordentown Townships terminate in the wetland and deliver significant loads of heavy metals from urban runoff into it (Simpson et al. 1981, 1983).

On a smaller scale, examination of aerial photographs (on file at the New Jersey Office of Environmental Analysis) of the wetland dating from 1930 show a variety of land use and other changes in the area most intensely studied (Fig. 2, site 6). In 1930 much of the area was agricultural, part apparently under cultivation and part meadows. What is now a forested island was the site of two prominent cultivated fields. A road, still depicted on topographic maps (United States Geological Survey, Trenton East Quadrangle 1981), extended toward the brick factory (Fig. 2, site 5). Also, ~1 km west of the road was a drainage ditch. Outlining the ditch, perhaps on spoil, were trees. A small forested island near the road was isolated and not connected to the forested bluff by shrub forest vegetation. Except for the prominant tributary of Crosswicks Creek, smaller drainage channels were not apparent. There was little change between 1930 and 1940 except for the construction of the sewage treatment plant east of the study site and increased urbanization of upland areas surrounding the wetland.

By 1951 the drainage ditch was not visible except by the position of a tiny island. The agricultural fields on the large island although open, were no longer cultivated. The


SPECIES
PERENNIALS
Nuphar advena
Pontederia cordata
Peltandra virginica
Acorus calamus
Sagittaria latifolia
Typha sp.
ANNUALS
Polygonum punctatum
Acnida cannabina
Ambrosia trifida
Bidens laevis
Polygonum arifolium
Impatiens capensis
Zizania aquatica var. aquatica
stream channel
bank
levee
high marsh
pond-like
ponds
shrub forest
forest
disturbed (upland)

	stream channel	bank	levee	high marsh	pond-like	ponds	shrub forest	forest	disturbed (upland)	TOTAL SPECIES
FLOODING DEPTH (cm)	0-200	0-100	0-20	0-30	0-100	30-150	0-30	none	none	
FLOODING PER TIDAL CYCLE (hr)	9-12	3-5	0-3	0-4	9-12	continuous	0-4	none	none	
SPECIES (#) Seed bank	16	42	28	58	•	•	57	•	•	94
Seedlings	1	17	15	21	•	•	13	•	•	28
Vegetation	7	16	23	50	19	17	80	114	103 (39)	409

FIG. 3. Diagrammatic representation of major habitats and distribution patterns for dominant wetland species. Numbers of species located in the various habitats (Tables 1, 2) are indicated. Adapted with permission from Simpson et al. (1983).

sewage treatment facility had expanded with filling of ~5 ha of adjacent wetland. In 1961 the agricultural fields were completely forested and the smaller island appeared connected to the hillside by shrub forest vegetation.

HABITATS

The Hamilton Marshes are classed as riverine and palustrine wetlands (Tiner 1985). The major habitats and their relationship to the tidal cycle are depicted in Fig. 3. Of the major wetland habitats, we believe that the pond and pond-like habitats are the 2 in which species composition has been most strongly influenced by human activity since colonial times. Many species may be found in more than one habitat but each is usually abundant in only one habitat. Distinct species associations, however, may occur in a given habitat (Whigham and Simpson 1975; Parker and Leck 1985). In the shrub forest, for example, tidally inundated areas support species characteristic of the high marsh. This vegetation type is interspersed with hummocks containing shrubs and herbs not usually found in the tidally inundated areas. The most widespread habitat, the high marsh, is spatially quite diverse and is dominated by a mixture of annuals and perennials. Some areas, however, are dominated almost exclusively by *Typha* sp. or other species (Whigham 1974).

VEGETATION

The species list (Table 1), compiled over a period of more than 10 yrs, summarizes distribution information by habitat type. The data base for Table 1 comes from our studies of species in the seed bank, as seedlings in the field, and as mature plants in the vegetation. Seed bank data are based on greenhouse studies carried out between 1976

TABLE 1. Species list and distribution in the seed bank, in the field as seedlings, and in the vegetation of flowering plants of the Hamilton Marshes. Site abbreviations are: C = Stream channel, SB = Stream Bank, L = Levee, HM = High Marsh, PL = Pond-like, P = Pond, SF = Shrub Forest, and F = Forest. Abundance abbreviations are: r = rare, i = infrequent, f = frequent, c = common, + present, – not observed/absent. Note: the SF seed bank and field seedlings data were from tidally inundated soil, but not hummocks, whereas vegetation data included both microhabitats. See text for an explanation of abundance categories.

Species	Seed Bank					Field Seedlings					Vegetation							
	C	SB	L	HM	SF	C	SB	L	HM	SF	C	SB	L	HM	PL	P	SF	F
Acer rubrum	–	–	–	–	–	–	–	–	r	–	–	–	–	–	–	–	c	i
A. saccharinum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	f
Acnida cannabina	c	c	c	f	–	–	c	c	c	–	–	c	c	i	–	–	–	–
Acorus calamus	–	–	–	–	–	–	–	–	–	–	–	i	–	c	–	–	f	–
Agrostis alba	–	r	–	–	r	–	–	–	–	–	–	–	–	–	–	–	+	–
Alisma subcordatum	–	–	–	r	–	–	–	–	–	–	–	–	–	+	–	–	+	–
Alnus rugosa	–	–	–	–	r	–	–	–	–	+	–	–	–	–	–	–	+	+
Ambrosia trifida	–	i	f	r	–	–	i	c	i	–	–	i	f	i	–	–	+	–
Andropogon virginicus	–	–	r	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Aster pilosus	r	r	r	r	r	–	–	–	–	–	–	–	–	–	–	–	+	+
Baccharis halimifolia	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Betula nigra	–	–	–	i	i	–	–	–	–	–	–	–	–	–	–	–	+	+
B. populifolia	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Bidens frondosa	–	–	r	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–
B. laevis	i	c	c	c	c	–	c	c	c	c	–	c	c	c	–	–	+	–
Boehmeria cylindrica	–	–	–	–	c	–	–	–	–	–	–	–	–	i	–	–	c	i
Callitriche heterophylla	i	c	c	f	c	–	c	c	c	c	–	f	–	–	–	–	–	–
Cardamine bulbosa	–	–	–	–	f	–	–	–	–	–	–	–	–	+	–	–	f	–
C. pensylvanica	–	–	–	r	c	–	–	–	r	–	–	–	–	i	–	–	i	–
Carex scoparia	–	–	–	r	c	–	–	–	–	–	–	–	–	–	–	–	+	–
C. stipata	–	–	–	–	c	–	–	–	–	–	–	–	–	–	–	–	+	–
C. swanii	–	–	–	–	f	–	–	–	–	–	–	–	–	–	–	–	–	–
Carex sp.	i	f	–	f	c	–	–	–	–	–	–	–	–	–	–	–	+	–
Carya ovata	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	i
Cephalanthus occidentalis	–	r	–	–	f	–	–	–	–	–	–	–	–	i	–	–	c	–
Chelone glabra	–	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	+	–
Cicuta maculata	–	r	r	r	f	–	r	r	r	f	–	–	r	i	–	–	i	–
Cinna arundinacea	–	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	+	+
Cornus amomum	–	–	–	–	f	–	–	–	–	+	–	–	–	–	–	–	f	–

TABLE 1. Continued

Species	Seed Bank					Field Seedlings					Vegetation							
	C	SB	L	HM	SF	C	SB	L	HM	SF	C	SB	L	HM	PL	P	SF	F
Cuscuta gronovii	–	i	r	c	c	–	r	r	c	c	–	r	r	c	–	–	f	–
Cyperus erythrorhizos	–	i	i	f	r	–	–	–	–	–	–	–	–	–	–	–	+	–
C. strigosus	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Cyperus sp.	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dioscorea villosa	–	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	+	+
Drosera rotundifolia L.	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dulichium arundinaceum	r	–	–	–	c	–	–	–	–	+	–	–	–	–	–	–	r	–
Echinochloa crusgalli	i	f	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Echinochloa walteri	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Epilobium coloratum	–	r	r	–	r	–	–	–	–	–	–	–	–	–	–	–	+	–
Erechtites hieracifolia	–	–	–	r	r	–	–	–	–	–	–	–	–	–	–	–	+	–
Erigeron annuus	–	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–
E. canadensis	–	–	–	r	i	–	–	–	–	–	–	–	–	–	–	–	–	–
Eupatorium dubium	–	r	–	i	c	–	–	–	+	–	–	–	–	–	–	–	i	+
E. purpureum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	i
Fraxinus americana	–	–	–	r	–	–	–	–	+	–	–	–	–	r	–	–	+	f
F. pennsylvanica	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	i
Galium obtusum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	i	–
Glyceria striata	–	–	–	–	r	–	–	–	–	–	–	–	–	i	–	–	–	–
Gnaphalium obtusifolium	–	–	–	i	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Gratiola neglecta	i	f	f	c	–	–	f	c	i	–	–	i	–	–	–	–	–	–
Heracleum maximum	–	–	–	–	–	–	–	–	–	–	–	–	–	r	–	–	–	–
Heteranthera multiflora/reniformis[a]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	i	f	–
Hibiscus palustris	–	r	r	r	–	–	–	–	+	–	–	–	–	i	–	–	+	–
Hypericum virginicum	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Impatiens capensis	–	f	f	c	c	–	f	f	c	c	–	i	c	c	–	–	c	f
Iris pseudacorus	–	–	–	r	–	–	–	–	–	–	–	–	–	+	–	–	+	–
Juncus effusus	–	f	f	i	c	–	–	–	–	–	–	–	–	i	–	–	+	–
J. tenuis	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Lactuca biennis	–	–	–	–	i	–	–	–	–	–	–	–	–	–	–	–	–	+
Leersia oryzoides	–	–	–	f	c	–	–	–	–	–	–	–	–	f	–	–	+	–
Lemna sp.	–	r	–	–	–	–	–	–	–	–	–	–	–	+	+	+	–	–
Liquidambar styraciflua	–	–	–	r	r	–	–	–	–	–	–	–	–	–	–	–	+	c

TABLE 1. Continued

Species	Seed Bank					Field Seedlings					Vegetation							
	C	SB	L	HM	SF	C	SB	L	HM	SF	C	SB	L	HM	PL	P	SF	F
Liriodendron tulipifera	–	–	–	–	i	–	–	–	–	–	–	–	–	–	–	–	–	c
Lonicera japonica	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	f
Ludwigia palustris	–	i	–	i	–	–	–	–	–	–	–	–	+	–	–	–	–	–
Lycopus virginicus	–	–	–	–	i	–	–	–	–	–	–	–	–	–	–	–	+	–
Lysimachia ciliata	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Lythrum alatum	–	–	–	–	–	–	–	–	–	–	–	–	–	i	–	–	–	–
L. salicaria	r	r	–	i	–	–	–	–	–	–	–	–	–	i	–	–	+	–
Microstegium vimineum	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Mikania scandens	–	i	i	c	c	–	–	–	–	–	–	–	–	i	–	–	+	+
Myosotis laxa	–	–	–	–	f	–	–	–	–	–	–	–	–	–	–	–	i	–
Nasturtium officinale	–	r	r	r	r	–	–	–	–	–	–	–	–	+	–	–	+	–
Nuphar advena	–	*r*	–	–	–	–	r	–	–	–	c	c	i	i	c	c	–	–
Nyssa sylvatica	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	f
Panicum dichotomiflorum	–	i	–	i	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Parthenocissus quinquefolia	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	+	f
Paulownia tomentosa	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Peltantra virginica	–	r	i	c	i	–	f	i	f	–	–	i	+	c	c	c	c	–
Phalaris arundinacea	–	r	c	f	i	–	–	–	–	–	–	–	c	c	–	–	–	–
Phragmites australis	–	–	–	i	i	–	–	–	–	–	–	–	–	+	–	–	–	–
Physocarpus opulifolius	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Pilea pumila	f	c	c	c	c	–	f	c	c	c	–	f	i	i	–	–	c	c
Poa trivialis	–	–	–	r	c	–	–	–	–	c	–	–	–	+	–	–	c	–
Polygonum arifolium	c	c	c	c	c	–	c	f	c	c	–	c	c	c	–	–	c	–
P. punctatum	c	c	f	i	c	–	c	r	–	–	–	c	f	–	c	–	–	–
P. sagittatum	–	i	f	c	–	–	i	i	r	–	–	–	i	–	–	–	–	i
Pontederia cordata	–	r	–	–	–	–	–	–	–	–	+	f	–	–	f	f	f	–
Populus heterophylla	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Potamogeton crispus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	i	i	–	–
Potentilla norvegica	–	–	–	i	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Prunus serotina	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	i	f
Quercus palustris	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	f
Q. rubra	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c
Ranunculus sceleratus	–	–	–	c	f	–	–	–	r	–	–	–	–	+	–	–	+	–

TABLE 1. Continued

Species	Seed Bank					Field Seedlings					Vegetation							
	C	SB	L	HM	SF	C	SB	L	HM	SF	C	SB	L	HM	PL	P	SF	F
Rhus radicans	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	i
Rosa palustris	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	f	–
Sagittaria latifolia	i	f	f	c	i	–	c	f	i	–	–	f	f	f	–	–	f	–
Salix spp.	–	–	–	r	r	–	–	–	–	–	–	–	–	–	–	–	+	–
S. bebbiana	–	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–
S. hybrid	–	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–
S. rigida	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	+	+
Sambucus canadensis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	i
Sassafras albidum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	i
Scirpus cyperinus	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	+	+
S. fluviatilis	–	–	–	–	–	–	–	–	–	–	–	–	–	f	–	–	–	–
Scutellaria lateriflora	–	–	–	–	i	–	–	–	–	–	–	–	–	–	–	–	+	–
Sium suave	–	i	–	c	c	–	–	–	f	f	–	–	r	i	–	–	i	–
Smilax herbacea	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	i
S. rotundifolia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	i
Solidago canadensis	–	r	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Thalictrum polygamum	–	–	–	–	f	–	–	–	–	–	–	–	–	–	–	–	f	–
Tovara virginiana	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	i
Typha angustifolia	–	–	–	–	–	–	–	–	–	–	–	–	–	f	–	–	–	–
T. latifolia	f	c	f	c	c	–	i	–	c	f	–	–	–	c	+	–	c	–
Ulmus rubra	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	i
Veronica peregrina	–	i	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–
Viburnum dentatum	–	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	c	c
V. prunifolium	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	c	i
Viola sororia	–	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	+	f
Vitis aestivalis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	i
Zizania aquatica	c	f	i	f	i	c	c	i	c	–	c	c	c	c	+	–	f	–
Totals 119					94					28								106

[a] *Heteranthera multiflora* and *H. reniformis* were not distinguished in this study. Both occur in Hamilton Marshes.

and 1986 (Leck and Graveline 1979; Parker and Leck 1985; Leck and Simpson 1987a and unpublished). Studies of seedling distribution in field plots, located near where soil samples had been obtained for the seed bank studies, were conducted in May of 1977 (Leck and Graveline 1979), 1983, 1984 (Leck and Simpson 1987a), and 1985 to 1987 (Leck and Simpson unpublished). They were monitored throughout the growing season in 1978 (Parker and Leck 1985). Studies of mature plants in the wetland have been conducted since 1974 (e.g. Whigham 1974; Whigham and Simpson 1975, 1976; Simpson et al. 1981, 1983b; Leck and Simpson 1987a).

For seed bank and field seedling density estimates the following were used: rare = 1–5 m^{-2}; infrequent = 6–25 m^{-2}; frequent = 26–100 m^{-2}; common = >100 m^{-2}; for the mature vegetation frequency data, based on percent of plots where a species occurred, the categories were delimited as: rare = 1–5%; infrequent = 6–25%; frequent = 26–50%; common = >50%. Because there was substantial variability from year to year for some species, the abundance category for a given species in a particular habitat, was based on the highest value for that species in that habitat. For example, for *Zizania aquatica* var. *aquatica* high marsh frequency values were 0% in 1972 and 40% in 1983. A (+) indicates that the species was present at the site. A (−) indicates that there was no observation for a species in a given habitat. This analysis for Table 1 is based on quantitative data from Whigham (1974), Leck and Graveline (1979), Parker and Leck (1985), and Leck and Simpson (1987a and unpublished).

Because the studies described above did not include any systematic floristic survey, additional species, found primarily during 1986–1987 surveys, are presented separately in Table 2. These surveys were not complete and it is expected that many more species are present. Also included are species recorded by J. Arsenault, R. Blicharz, and A. E. Schuyler, or represented by herbarium specimens at The Academy of Natural Sciences of Philadelphia. Herbarium specimens, prepared for more than half of all species, are deposited in the Rider College herbarium.

Nomenclature follows Fernald (1950) except for some species such as *Phragmites australis* and *Microstegium vimineum* which are in accordance with more recent literature (e.g. Hough 1983).

DISCUSSION

The number of flowering plant species found in each habitat can be seen of Fig. 3. Over the more than 10 yrs of our studies, we have identified 409 species (exclusive of several unidentified graminoids and 1 dicot) (Tables 1, 2). Many more species (94) germinated from seed bank samples in the greenhouse than were observed in the field as seedlings (28) (Table 1) or established plants (24) in comparable studies (Leck, Simpson, and Parker 1988). The total (Tables 1, 2) was 426 species.

Various factors may account for the absence of many species as seedlings in the field. Soil disturbance during collection for seed bank studies may have provided dormant seeds with a stimulating light environment (Wesson and Waring 1969; Baskin and Baskin 1985). Furthermore, a favorable alternating temperature regime in the greenhouse may have elicited germination. In the field, vegetation canopy and/or litter could inhibit light-requiring species as well as those requiring specific alternating temperatures. Also, the continuously wet, and frequently inundated (<5 cm) soils found in the wetland may reduce or prevent germination (Leck and Simpson 1987a). Biotic stress, e.g. competition, would be more intense in the field (Parker and Leck 1985). Finally,

TABLE 2. Hamilton Marsh species other than those presented in Table 1. Species provided by J. Arsenault (*), R. Blicharz (**) and A. E. Schuyler, including specimens in the Academy of Natural Sciences of Philadelphia herbarium (+) are so indicated. The habitat in which each species was found is noted as: forest (F), wetland (including shrub forest) (W), and disturbed (D) or open upland (D′). Disturbed areas include road construction and other obviously man-altered sites. Open upland sites are areas where disturbance may have occurred, but are now open and sandy spots (e.g., on Duck Island and near Spring Lake). Species may also occur in habitats other than those noted here.

SEED PLANTS. *Acalypha virginica* (D), *Acer negundo* (F), *Acer platanoides* (F), *Acer pseudo-platanus* (F), *Achillea millefolium* (D), *Agastache scrophularifolia*** (F), *Ailanthus altissima* (D), *Alliaria officinalis* (F), *Allium vineale* (F), *Alnus serrulata* (W), *Ambrosia artemisiifolia* (D), *Amorpha fruticosa* (D′), *Amphicarpa bracteata* (F), *Andropogon gerardii* (D′), *Andropogon scoparius* (D′), *Andropogon virginicus* (D′), *Anthemis cotula* (D), *Apios americana* (W), *Apocynum androsaemifolium* (D′), *Apocynum cannabinum* (D), *Arabis laevigata* (Muhl.)** (F), *Arisaema triphyllum* (F), *Aristida dichotoma* (D′), *Artemesia vulgaris* (D), *Arthraxon hispidus** (D), *Asarum canadense*** (F), *Asclepias incarnata** + (W), *Asclepias syriaca* (D), *Asparagus officinalis* (D), *Aster divaricatus* (D), *Aster puniceus* (W), *Aster simplex* (D), *Aster vimineus** (D), *Berberis vulgaris* (F), *Bidens bidentoides* + (W), *Bidens comosa* + (W), *Bidens connata* + (W), *Bidens coronata* + (D), *Bidens polylepis* (W), *Broussonetia papyrifera** (D), *Cabomba caroliniana* (W), *Caltha palustris* + (W), *Capsella bursa-pastoris* (D), *Carex crinita* (W), *Carex grayii* (W), *Carex intumescens* + (W), *Carex lacustris* + (W), *Carex lupulina* (F), *Carex projecta* + (W), *Carex rosea** (F), *Carex squarrosa* + (W), *Carex straminea* (D), *Carex stricta* (W), *Carex vulpinoidea* + (W), *Carpinus caroliniana* (F), *Carya cordiformis* (F), *Cassia fasciculata* (D′), *Cassia nictitans* (D′), *Catalpa bignonioides* (D), *Celastrus scandens* (F), *Celtis occidentalis* (F), *Centaurea maculosa* (D), *Ceratophyllum demersum** + (W), *Chelidonium majus*** (F), *Chenopodium album* (D), *Chenopodium ambrosioides* (D), *Chimaphila maculata* (F), *Chrysanthemum leucanthemum* (D), *Cicuta bulbifera* (W), *Circaea quadrisulcata** (F), *Cirsium arvense* (D), *Cirsium vulgare* (D), *Claytonia virginica* (F,W), *Clematis dioscoreifolia* (F), *Clematis virginiana* (F), *Clethra alnifolia* (F), *Commelina communis* (D), *Convolvulus sepium* (W), *Cornus florida* (F), *Coronilla varia* (D), *Corydalis flavula*** (F), *Cycloloma atriplicifolium* (D), *Cyperus dentatus* (D), *Cyperus filiculmis* (D), *Cyperus ovularis* (F), *Dactylis glomerata* (D), *Daucus carota* (D), *Desmodium canescens** (F), *Desmodium cuspidatum* (D′), *Dianthus armeria* (D), *Dicentra cucullaria*** (F), *Digitaria sanguinalis* (D), *Dioscorea batatas* (D), *Diospyros virginiana* (F), *Eleocharis acicularis* + (W), *Eleocharis obtusa* (W), *Eleusine indica* (D′), *Elodea nuttallii* (W), *Elymus virginicus** (F), *Eragrostis hypnoides* + (W), *Eragrostis spectabilis* (D′), *Eriocaulon parkeri* + (W), *Erythronium americanum*** (F), *Euonymus alatus* (D), *Eupatorium hyssopifolium* (D′), *Eupatorium perfoliatum* (D), *Eupatorium rugosum* (F), *Euphorbia chamissonis* (D′), *Euphorbia corollata* (D′), *Fagus grandiifolia* (F), *Fagopyrum sagittatum*** (D), *Festuca rubra* (D), *Froelichia gracilis* (D), *Galium aparine* (W), *Galium tinctorium* (D), *Geum canadense* (W), *Geum laciniatum** (F), *Glechoma hederacea* (D), *Glyceria pallida* + (W), *Glyceria septentrionalis* (F), *Helenium autumnale* (D), *Helianthus annus*** (D), *Helianthus decapetalus*** (F), *Helianthus tuberosus* (D), *Hieracium pratense* (D′), *Hordeum jubatum* (D), *Hosta plantaginea* (D), *Houstonia caerulea* (D′), *Humulus japonicus* (D), *Hypericum mutilum* (D), *Hypericum perforatum* (D), *Hystrix patula* + (W), *Ilex opaca* (F), *Ilex verticillata* (W), *Iris versicolor* (W), *Juncus acuminatus* (D), *Jussiaea repens* (W), *Justica americana* + (W), *Krigia virginica*** (D′), *Lactuca canadensis* (D), *Lamium amplexicaule*** (D), *Laportea canadensis* (F), *Lechea villosa* (D′), *Leersia virginica* (D), *Lemna minor** (W), *Leonurus cardiaca** (D), *Lepidium* sp. (D), *Lespedeza capitata* (D′), *Lespedeza intermedia* (D′), *Ligustrum vulgare*

TABLE 2. Continued.

(D′), _Lilium_ sp. (W), _Linaria canadensis_** (D′), _Lindera benzoin_ (W, F), _Lindernia dubia_ + (W), _Lobelia cardinalis_ + (W), _Lobelia inflata_ (D), _Lobelia siphilitica_** (W), _Lolium perenne_ (D), _Lonicera morrowii_ (D), _Lonicera xylosteum_ (D′), _Ludwigia alternifolia_ (D), _Luzula multiflora_* (D), _Lycopus americanus_* + (W), _Melilotus alba_ (D), _Melilotus officinalis_ (D), _Mimulus alatus_ + (W), _Mimulus ringens_ (D), _Mollugo verticillata_ (D), _Monotropa uniflora_* (F), _Morus alba_ (F), _Myriophyllum heterophyllum_ + (W), _Myriophyllum spicatum_ (W), _Nymphaea odorata_ (W), _Oenothera biennis_ (D), _Orontium aquaticum_ + (W), _Osmorhiza longistylis_* (F), _Oxalis stricta_ (F), _Panicum anceps_ (F), _Panicum clandestinum_ (D), _Panicum latifolium_ (W), _Panicum stipitatum_ + (W), _Panicum virgatum_* (D′), _Penthorum sedoides_ (D), _Philadelphus coronarius_ (F), _Phytolacca americana_ (F), _Pinus rigida_ (D′), _Plantago aristata_ (D), _Plantago lanceolata_ (D), _Plantago rugelii_ (D), _Platanus occidentalis_ (F), _Poa compressa_ (D), _Podophyllum peltatum_ (F), _Polygonatum biflorum_ (F), _Polygonum amphibium_ (W), _Polygonum cespitosum_ (D), _Polygonum cuspidatum_ (D), _Polygonum hydropiperoides_ (W), _Polygonum lapathifolium_ (D), _Polygonum orientale_ + (D), _Polygonum pensylvanicum_ (D), _Polygonum scandens_ (F), _Populus grandidentata_ (D), _Populus tremuloides_ (D), _Potamogeton diversifolius_ + (W), _Potamogeton epihydrus_ + (W), _Potamogeton pectinatus_ + (W), _Potentilla simplex_ (F), _Prunella vulgaris_ (D), _Ptilimnium capillaceum_* (W), _Pycnanthemum muticum_ (F), _Pycnanthemum virginianum_** (D′), _Pyrus prunifolia_ (D′), _Quercus phellos_ (F), _Ranunculus abortivus_ (F), _Ranunculus longirostris_ + (W), _Rhexia virginica_ (D), _Rhus copallina_ (D′), _Rhus typhina_ (D′), _Rhus glabra_ (W), _Robinia pseudo-acacia_ (D′), _Rosa multiflora_ (DF), _Rubus pensilvanicus_ (W), _Rubus phoenicolasius_ (F), _Rudbeckia hirta_ (D), _Rudbeckia lacinata_ (W), _Rumex crispus_ (D), _Rumex obtusifolius_** (F), _Sagittaria rigida_ + (W), _Sagittaria subulata_ + (W), _Salix fragilis_* (D), _Salix humulis_ (? _S. tristis_) (D), _Saponaria officinalis_ (D), _Scirpus polyphyllus_ (D), _Scirpus pungens_ + (W), _Scrophularia marilandica_* (F), _Scutellaria epilobiifolia_** (W), _Scutellaria integrifolia_ (D′), _Senecio aureus_ (F), _Setaria faberii_ (D), _Setaria glauca_ (D′), _Sisyrinchium angustifolium_ (D′), _Smilacina racemosa_ (F), _Solanum dulcamara_ (F), _Solanum nigrum_ (D), _Solidago caesia_* (F), _Solidago graminifolia_ (D), _Solidago juncea_ (D), _Solidago rugosa_ (D), _Solidago sempervirens_* (W), _Sorghastrum nutans_ (D′), _Sparganium americanum_ + (W), _Sparganium eurycarpum_ + (W), _Spartina pectinata_ + (W), _Specularia perfoliata_ (D), _Spergularia rubra_ (D′), _Spiraea latifolia_ (W), _Spirea tomentosa_ (D), _Spirodela polyrhiza_* (W), _Stachys palustris_ + (W), _Stachys tenuifolia_ var. _hispida_ (W), _Stellaria longifolia_ (W), _Symplocarpus foetidus_ (F), _Taraxacum officinale_ (D), _Taxus_ sp. (D), _Teucrium canadense_* (F), _Tilia americana_ (F), _Trichostema dichotomum_ (D′), _Trifolium agrarium_ (D), _Trifolium arvense_ (D), _Trifolium pratense_ (D), _Trifolium repens_ (D), _Triodia flava_ (D′), _Utricularia intermedia_ + (W), _Utricularia vulgaris_ + (W), _Uvularia sessilifolia_ (F), _Vaccinium corymbosum_ (F), _Vallisneria americana_ + (W), _Verbascum blattaria_ (D), _Verbascum thapsus_ (D), _Verbena urticifolia_* (F), _Veronica longifolia_** (D′), _Viola kitaibeliana_** (D′), _Vitis labrusca_ (F), _Vitis riparia_* (F), _Vitis vulpina_ (D), _Wisteria floribunda_ (F), _Wolffia columbiana_* (W), _Xanthium strumarium_ (D).

FERNS AND HORSETAILS (see also Leck and Simpson 1987b). _Asplenium platyneuron, Athyrium felix-femina, Botrychium dissectum, Botrychium virginianum, Dennstaedtia punctilobula, Dryopteris noveboracensis, Dryopteris spinulosa, Dryopteris thelypteris, Equisetum arvense, Equisetum fluviatile, Onoclea sensibilis, Osmunda cinnamomea, Osmunda claytoniana, Osmunda regalis, Polystichum acrostichoides, Pteretis pensylvanica (Matteuccia struthiopteris), Woodwardia areolata._

finding seedlings of graminoids, for which we have poor "search images" anyway, and of uncommon species is difficult in the field.

Seed input, distribution, and turnover are clearly important to species diversity. Most species, especially annuals, produce large numbers of seeds (e.g. Whigham and Simpson 1977; Simpson, Leck, and Parker 1985; Sickels and Simpson 1985; and unpublished data) and many have seeds which are water dispersed (e.g. West and Whigham 1976; Parker and Leck 1985). Many fewer species germinated in samples collected in June suggesting high turnover rates and short lived seeds for many seed bank species. Many species have seeds that appear not to survive for long periods; 40% of the species found in seed bank samples occur only in the surface (0–2 cm) and ~30% germinate only in March (Leck and Simpson 1987a).

Many species are very uncommon in the seed bank, yet they collectively add considerable diversity to the seed bank (Leck and Simpson 1987a). In turn, the seed bank is considerably more diverse than the wetland flora at any one time and provides for recruitment of species which germinate if conditions change within any wetland habitat (Leck, Simpson, and Parker in press).

There are also some species that occur regularly in one or more habitats but have not been found in the seed bank or in the field as seedlings. For some of these, e.g. *Acorus calamus* and *Scirpus fluviatilis,* seed production does not occur or is limited (Packer and Ringius 1984; A. E. Schuyler pers. comm.). For others dispersal may be limited. Of the 21 woody species in the seed bank, *Cornus amomum* and *Viburnum dentatum*, are bird dispersed; the other 19 are wind or water dispersed. Despite seemingly effective dispersal mechanisms, only *Cephalanthus occidentalis* was frequent in the seed bank. Various common species, such as *Rhus radicans* and *Ilex verticillata*, which have bird dispersed fruits, were not found in seed bank soil samples or as seedlings. Clearly, more information about the production, dispersal, longevity, and germination of most species is needed before we can understand existing vegetation patterns or processes responsible for temporal changes in the vegetation.

Six species, *Bidens bidentoides, Eriocaulon parkeri, Justicia americana, Populus heterophylla, Ranunculus longirostris,* and *Sagittaria subulata* are among the rare and endangered species of New Jersey (Snyder and Vivian 1981). *Populus heterophylla* was represented by a single seed bank plant; the others are herbarium records (Academy Natural Sciences of Philadelphia). Of the rare Pennsylvania species found in the Delaware River estuary (Schuyler 1986), *Acnida cannabina* (*Amaranthus cannabinus*), *Bidens bidentoides, Bidens laevis, Echinochloa walteri, Eriocaulon parkeri, Ptilimnium capillaceum, Sagittaria subulata, Scirpus fluviatilis, and Zizania aquatica* are known from the Hamilton Marshes. *Sagittaria subulata, Bidens bidentoides,* and *Eriocaulon parkeri* were collected near the mouth of Crosswicks Creek, and *Echinochloa walteri* was represented by a single seed bank plant. *Acnida cannabina, Bidens laevis,* and *Scirpus fluviatilis* are common. Of nine rare intertidal species with ranges encompassing Crosswicks Creek (Ferren and Schuyler 1980), *Bidens bidentoides, Eriocaulon parkeri, Sagittaria subulata, Scirpus fluviatilis,* and *Zizania aquatica* occur in the Hamilton Marshes.

Abbott's (1887) 19th century description of his wanderings in the wetland included reference to more than 90 species. Of these, 16 are not among those presented in Tables 1 and 2. Two of the 16, *Nelumbo lutea* (Willd.) Pers. and *Castanea pumila* (L.) Mill., are rare or endangered in New Jersey (Snyder and Vivian 1981); and only 2, *Gerardia flava* L. and *Nelumbo lutea,* are not listed for Mercer County (Hough 1983). (Evidence that

Nelumbo lutea ever occurred in the wetland is dubious—A. E. Schuyler, pers. comm.). *Anemone nemorosa* and *Castanea vesca,* names not included in Fernald (1970), probably are *A. quinquefolia* and *C. dentata,* respectively.

Compared with Tinicum Marsh with 739 species (McCormick 1970), the Hamilton Marsh to date has 426 species of which 203 also occur in Tinicum. This reflects, in large part, the more comprehensive survey of the Tinicum vegetation by Wherry and McCormick. There were, however, 17 ferns/horsetails recorded in the Hamilton Marsh and only 12 in Tinicum; 9 were common to both wetlands.

All species mentioned for Woodbury Creek marshes (Good and Good 1975; Good, Hastings, and Denmark 1975), occurred in the Hamilton Marshes. Among the Oldmans and Salisbury marsh species (McCormick and Ashbaugh 1972; McCormick 1977), only *Bidens bipinnata* did not also occur in the Hamilton Marshes.

The Hamilton Marshes, as noted above, long the site of human activity, continue to be used by man for various activities. In addition to having status as a national landmark, a northern portion is the John A. Robeling Memorial Park, an important natural area for viewing marsh birds (Hawkins and Leck 1977; Boyle 1986) and a southern portion is the Duck Island State Recreation Area. Use for muskrat trapping, deer hunting, and fishing is common. Also, it continues to suffer the impact of development. The forest at the north edge along the bluffs (Fig. 2) was removed in 1985 for road construction. The interchange for Interstate-195-295 and associated highways will substantially alter the landscape and change the ambience. Our wetland studies have helped provide a better understanding of the importance of the wetland (Simpson et al. 1983) and of vegetation dynamics (Leck, Simpson, and Parker 1988). This survey of the vasular plant species, while incomplete, provides an overview of the rich species diversity of the Hamilton Marshes. We hope that it will be a useful baseline against which to evaluate the continuing impact of human activity.

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Aeschynomene rudis Benth. (Fabaceae) in the United States

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Aeschynomene (Fabaceae) is a genus of about 150 to 160 species found in the tropics and in warm temperate regions. The genus is characterized by papilionaceous flowers and jointed legumes. The leaves are sensitive to light, often folding at night. Sometimes the leaves are also sensitive to touch, hence the common name "sensitive joint vetch" that is often applied to many *Aeschynomene* species. The species range from herbaceous annuals to shrubby perennials. Most species are erect in habit, but a few species are prostrate (Rudd 1955; Kretschmer and Bullock 1979).

Aeschynomene rudis Benth. is classified in section Aeschynomene, series Indicae (Rudd 1955). *Aeschynomene rudis* is native to South America, and apparently introduced into North America; Rudd (1955) mentioned only two locations for *A. rudis* in the United States. However, this species has been overlooked in the compilation of most state and regional floras in the United States. As a result, specimens of *A. rudis* collected in the United States have been designated as *A. indica* or *A. virginica*. Recent annotations by Duane Isely (UARK) and Edwin B. Smith (UARK), as well as independent investigations by Arthur O. Tucker (DOV) and John Carulli (CHRB), have resulted in the proper recognition of *A. rudis* in the flora of North America. We present a key to separate *A. rudis* from *A. virginica* and *A. indica*, the diagnostic characters of these three species (Table 1), and a description and geographic distribution of *A. rudis* in the United States.

1. Mature fruit stipe 3–10 mm 2
  2. Teeth on floral bracts rarely absent. Leaflets 6–25 mm .... *A. rudis*
  2a. Teeth on floral bracts rarely present. Leaflets 2.5–13 mm .... *A. indica*
1a. Mature fruit stipe 10-25 mm .... *A. virginica*

Aeschynomene rudis Benth.

Stem to about 2 m high, hispid to glabrous. Leaves even-pinnate, 4.0 to 15.0 (17.5) cm long; petioles 0.5 to 1.5 (2.5) cm long, hispidulous. Leaflets 30 to 50 per leaf, opposite to slightly sub-opposite; leaflets 6 to 25 mm long, 1.5 to 4 mm wide; leaflets usually entire. Stipules peltately attached, 1.0 to 1.5 (2.0) cm long, usually toothed or ciliate-margined. Racemes axillary, rachises and peduncles glandular-pubescent; raceme adorned with one or two diminutive leaves; pedicels subtended by toothed bracts; flowers subtended by pairs of toothed bracts 3 to 4.5 mm long. Petals yellow to orange with red markings; corolla 8 to 10 (15) mm long; calyx 4 to 6 mm long. Jointed legumes 3.5 to 6.5 cm long; stipe (3) 4 to 6 (10) mm long; individual segments 5 to 6 mm long and wide; 7 to 12 segments per fruit. Flowering from July to October.

In the United States, *A. rudis* is found in roadside ditches and in agricultural fields, while historically it was found introduced on ballast islands. The oldest United States specimens are from Mobile County, Alabama (1878), Louisiana (no county given, pre-1856), and Delaware County, Pennsylvania (1875). The species behaves as an an-

TABLE 1. Diagnostic morphological characters of *A. rudis*, *A. indica*, and *A. virginica*. Data were compiled from Rudd (1955), Wilbur (1963), Radford, Ahles, and Bell (1968), and personal observations of the authors.

Character	*A. rudis*	*A. indica*	*A. virginica*
leaflets per leaf	30–50	30–74	30–56
length × width of leaflets	6–25 × 1.5–4 mm	2.5–13 × 1–2.5 mm	6–25 × 2–5 mm
length of standard	8–12(15) mm	7–10 mm	8–12(15) mm
teeth on floral bract	rarely absent	rarely present	rarely absent
length of fruit stipe	3–10 mm	3–10 mm	10–25 mm
Length × width of fruit segments	5–6 × 5–6 mm	4–5 × 3.5–5.5 mm	5–7 × 4.5–6.5 mm
U.S. distribution	Coastal States, Pennsylvania to Florida, west to Texas, Arkansas	Coastal States, North Carolina to Florida, west to Texas, Arkansas	Coastal States, New Jersey to North Carolina

nual, although plants may become quite woody by the end of the growing season. The plants are often found in very wet areas, occasionally in standing water. Rudd (1955) reports specimens from Alabama and Louisiana. In our search of 19 herbaria (CHRB, CLEMS, DOV, DUKE, FLAS, FSU, GA, GH, LSU, LTU, NCU, NLU, NY, PH, TEX, UARK, UNA, US, USCH) we have discovered the following specimens.

ALABAMA: Mobile Co.: Mobile, C. Mohr, Aug 1878 (US). ARKANSAS: Arkansas Co.: Rice field E of Stuttgart, D. M. Moore, 13 Aug 1938 (TEX); 1.9 mi SW of Stuttgart city limits on Highway 79, wet ditch near soybean field, E. B. Smith 3878, 26 Aug 1985 (UARK); 2.9 mi S of University of Arkansas Experiment Station by Highway 130, few in cornfield, E. B. Smith 3880, 26 Aug 1985 (UARK); Cross Co.: 1.2 mi W of intersection of Highway 64 and Highway 75 on Highway 75W, along side of road in wooded area, C. Wright 41, 26 Sep 1970 (UARK); 4 mi W of Wynne on county road off of Highway 64, rice levee, D. T. Brown 11, 29 Jul 1967 (UARK); Lonoke Co.: Along Highway 15, 6.4 mi N of junction of Highway 15 and Highway 165, scattered in wet ditch by rice field, E. B. Smith 3871, 26 Aug 1985 (UARK); Scattered in roadside ditch by Highway 165, 4 mi E of the town of Coy, E. B. Smith 3872, 26 Aug 1985 (UARK); Common in wet ditch by Highway 165, on E side of town of Humnoke, E. B. Smith 3874, 26 Aug 1985 (UARK); Scattered near cornfield by Highway 165, 3.7 mi N of the town of England, E. B. Smith 3887, 27 Aug 1985 (UARK); Fish farm, 2 mi W of Lonoke, on Highway 70, M. P. Locke 4993, 31 Aug 1982 (UARK); Prairie Co.: In ditch at edge of Konechy's grove, 2.5 mi W and S of Highway 11, 9.5 mi S of Hazen, P. McCoy 398, 10 Sep 1970 (UARK); Scattered in wet ditch by Highway 11, 0.5 mi S of the junction of Airport 980 Road (Stuttgart Airport) and Highway 11, E. B. Smith 3877, 26 Aug 1985 (UARK); St. Francis Co.: 2 mi W of Palestine, local along irrigation ditch, flowers copper-red, stem 4 ft tall, S. McDaniel 1373, 9 Sep 1959. FLORIDA: Lake Co.: 0.7 mi S of the southern city limit of Umatilla, ditch (with standing water) on the east side of Route 19, D. E. Fairbrothers, J. P. Carulli, and R. S. Wallace, 16 Aug 1985 (CHRB, DOV). GEORGIA. McIntosh Co.: On dike, Butler Island, Darien, W. J. Harmer 41, 23 Jul 1958 (US); In 6 in water, edge of diked pond, Butler Island, Darien, W. J. Harmer 1116, 28 Jul 1960 (US); Edge of flooded field, Butler Island, Darien, W. J. Harmer 1332, 13 Sep 1961 (GH, US). LOUISIANA: Edges of ponds and marshes, J. Hale, Sep (x-1856) (GH, NY); S. T. Olney (1812–1878) (GH); LaSalle Parish: Old River beside U.S. Highway 84, 9 mi SE of Jena, K. E. Rogers 2538-13, 9 Nov 1969 (NCU). NORTH CAROLINA: Brunswick Co.: Waste land and marsh margins, Orton Plantation, C. R. Bell 16220, 18 Oct 1958 (DUKE, GH, NCU). PENNSYLVANIA: Philadelphia Co.: Near Philadelphia, E. Durand (1794–1873) (PH); Delaware Co.: Haverford; J. W. Eckfeldt, 3 August 1875 (PH). SOUTH CAROLINA. Jasper Co.: Sandy roadside bordering brackish marsh, 0.7 mi N of Savannah River on U.S. Route 17A, H. E. Ahles 18155 and C. R. Bell, 7 Sep 1956 (DUKE, NCU). TEXAS: Harris Co.: In water of roadside freshwater canal stream, about 11 mi N of Addicks, D. S. Correll 31894, 6 Oct 1965 (NY).

ACKNOWLEDGMENTS

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Bartonia No. 54: 21–23, 1988

Heteranthera multiflora in New Jersey: A First Look

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Heteranthera multiflora (Griseb.) Horn is a low growing aquatic herb found in a variety of wetland habitats in the central and eastern United States and in South America (Horn 1985). Although often locally abundant where found, its range is discontinuous, and it is rare or absent throughout major portions of its range (Horn pers. comm.). This is especially true along the Atlantic Seaboard where the species is known from a small number of mostly old collections from southern New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina. Originally described by Grisebach in 1879 as a variety of *H. reniformis* R. & P., its status as a species was recently determined by C. N. Horn (1985, 1986). No collections from the eastern United States were made by Horn and consequently little information is available on its current distribution and abundance there. Observations on some recently discovered New Jersey populations are reported in this paper with the hope of stimulating additional fieldwork on the species in the East.

Heteranthera multiflora resembles both *H. peduncularis* Benth. and *H. reniformis* in gross morphology and most misidentifications involve these two species. *Heteranthera peduncularis* is a species occurring primarily in the Mexican highlands (Horn pers. comm.), and it therefore should not be a source of confusion in the eastern states.[1] The ranges of *H. multiflora* and *H. reniformis* overlap in the United States but *H. multiflora* is more typical of the central and eastern Plain states (Horn 1985).

It is possible to distinguish *H. multiflora* and *H. reniformis* by vegetative characters but the differences are subtle and overlaps exist, especially in dimensions (Horn pers. comm.). The two species are best separated by differences in inflorescence and floral structures. The following key has been modified from information provided by C. N. Horn.

Internode of flowering stem less than 1 cm; spike longer than the spathe (the inflorescence is sometimes included within the spathe, especially on the Atlantic Coastal collections); inflorescence with 3–16 flowers; filament hairs purple; perianth pale purple or white, scarcely glandular pubescent; sessile leaves of seedling on elongate stem .... *H. multiflora*.

Internode of flowering stem 0.5–4 cm; spike shorter than the spathe (tip of some flowers may extend beyond spathe); inflorescence with 2–8 flowers; filament hairs white; perianth white (rarely blue), densely glandular pubescent on outside; sessile leaves of seedling in basal rosette ..... *H. reniformis*.

The chromosome number for *H. multiflora* is $2n = 32$ and the number for *H. reniformis* is $2n = 48$ (Horn 1985).

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[1] The description of *H. peduncularis* in H. A. Gleason's the New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada more closely describes *H. multiflora*. The leaves of *H. peduncularis* are distinctly cordate, not cordate-rotund and its filaments are glabrous, not pilose. Also, the range is given as "W. Mo. and e. Kan.; also in Mexico." which further indicates that two taxa have been combined in this treatment since *H. peduncularis* is not known from Missouri or Kansas, and *H. multiflora* is not known from Mexico. According to Horn this is one of several publications which have referred to *H. multiflora* as *H. peduncularis*.

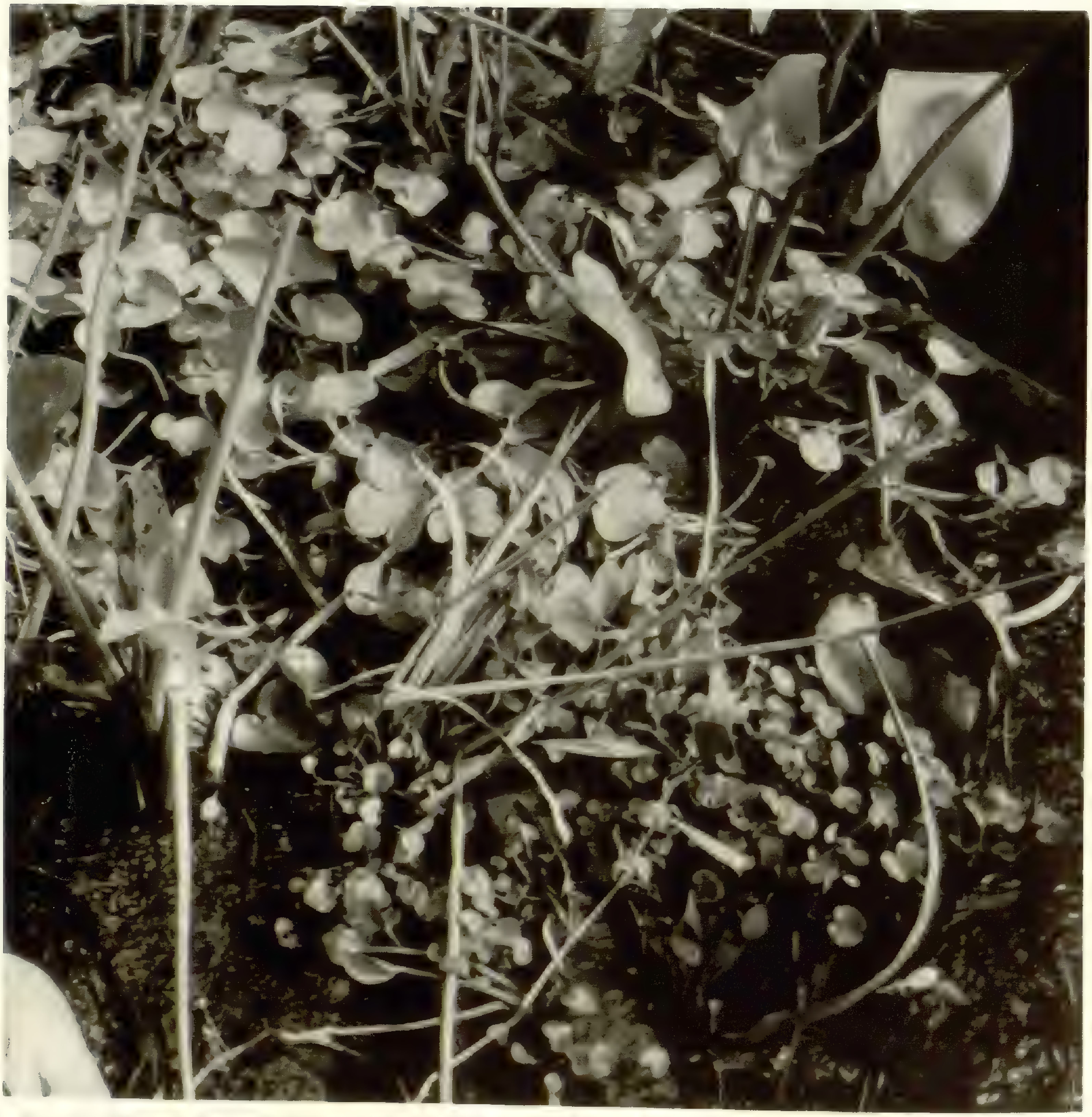

FIG. 1. *Heteranthera multiflora* growing with taller plants of *Pontederia cordata* (upper portion of photograph) and smaller plants of *Heteranthera reniformis* (lower portion of photograph).

The known distribution of *H. multiflora* in New Jersey is Coastal Plain where it is vouchered from sites along the Delaware River, or from river systems draining into it. Most historic New Jersey locations are represented by specimens contained in the local collection of the Academy of Natural Sciences of Philadelphia where there are eleven specimens from ten localities in Burlington, Camden, Gloucester, and Salem counties.[2] All these specimens were originally labeled *H. reniformis* and were determined *H. multiflora* by C. N. Horn in 1984. Many of the collections are from tidal river systems, a habitat that Horn considers atypical for the species. The earliest known

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[2] *Heteranthera multiflora* is also reported from the Hamilton Marshes in Mercer County by Leck et al. in this issue of Bartonia.

New Jersey specimen is an 1879 collection from Camden by C. F. Parker in the Chrysler Herbarium at Rutgers University.

I collected specimens of what I suspected to be *H. multiflora* at two sites along the Delaware River in Burlington and Camden counties, New Jersey on 23 October 1986. Photographs and photocopies of the Camden County specimens were sent to C. N. Horn who identified them as *H. multiflora*.

The Camden County site was revisited on 11 September 1987 by T. Breden, A. E. Schuyler, and me and additional specimens were collected. The collection locality is an extensive freshwater intertidal marsh at Fish House Cove just south of Delair. *H. multiflora* is frequent here and a conspicuous part of the intertidal vegetation, forming in places monospecific stands a meter or so across. It typically occupied the higher limits of the middle vegetation zone where it grew at the edge of a dense stand of *Typha angustifolia* L. and *T.* × *glauca* Godr. associated with *Peltandra virginica* (L.) Schott, *Sagittaria rigida* Pursh, *Pontederia cordata* L., *Polygonum punctatum* Ell., and occasionally *H. reniformis*. For the most part, however, we found *H. reniformis* occupying deeper, and less densely vegetated zones of the marsh where it occurred with *Nuphar lutea* (L.) Sibthorp & Sm., *Sagittaria graminea* Michx., *S. subulata* (L.) Buch., *Eleocharis parvula* (R. & S.) Link, and *Ludwigia palustris* (L.) Ell. Both species of *Heteranthera* were in flower and we had a little difficulty determining the two species in the field.

We later found *H. multiflora* in a tidal marsh along Rancocas Creek at Centerton, Burlington County. Conditions were similar to the Delair occurrence but a rising tide prevented a detailed survey.

Just how abundant *H. multiflora* is in New Jersey remains to be determined, but preliminary fieldwork indicates that it may be more frequent than collections now indicate.

ACKNOWLEDGMENTS

I thank Charles Horn for making available much of the information on *H. multiflora* presented in this paper. T. Breden and A. E. Schuyler are thanked for their comments and help with the field work, and Lorri Stemmer for typing the manuscript.

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The First Pennsylvania Record of the Upright Primrose-Willow (*Ludwigia decurrens* Walt.)

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On 3 August 1987, we discovered a population of *Ludwigia decurrens* Walt. while conducting a floristic survey of islands in Lake Aldred on the Susquehanna River, in conjunction with Enn Kotkas, Radiation Management Corporation, Muddy Run Ecological Laboratory. The plants were flowering and distributed over an area of approximately 16 square meters, and consisted of about 10 individuals. Voucher specimens are deposited at the Academy of Natural Sciences of Philadelphia.

The site is located 18 kilometers due south southwest of Lancaster in Lancaster County, Pennsylvania, on the 40 hectare Weise Island at an elevation of 51 meters. Weise Island is at the northern edge of the Piedmont Upland Section of the Piedmont Province. The parent substrate is Cambrian and Precambrian igneous and metamorphic crystalline rocks, schists, gneisses, and quartzites (Guilday 1985). The associated soil is alluvial (Carey 1959) on an eastern slope of 0 to 3 degrees. A sandy beach surrounds the island. The dominant vegetation of the island consists of two zones, *Acer saccharinum* in the center and *Lythrum salicaria* surrounding the center. *Ludwigia decurrens* was found on the interface of the sandy beach and the *Lythrum salicaria* zone where total plant cover is approximately 75% by visual estimate. This zone is subject to frequent disturbance by water level fluctuations on Lake Aldred. Additional species observed on the eastern side of the island are listed in the appendix. The site is owned by the Pennsylvania Power & Light Company.

Ludwigia decurrens ranges from Maryland and West Virginia to Florida and eastern Texas, north in the interior to southern Indiana, southern Illinois, southern Missouri, and Oklahoma, and south to northern Argentina (Deam 1940; Correll and Correll 1975; Fernald 1970; Gleason 1952). Its common habitat is alluvial shorelines subject to water level fluctuations. The species has not previously been reported from Pennsylvania (Wherry et al. 1979), and the site described above constitutes the northern-most known locality for this species.

In Maryland the species appears to be widely distributed in disturbed wetlands of fall line and coastal plain counties, but is still considered a watch-list species by the Maryland Natural Heritage Program (Ludwig pers. comm.; Brown and Brown 1984). The species is commonly found throughout its southeastern range from Virginia south to Florida and west to eastern Texas (Rouse pers. comm.; Radford et al. 1968). In the interior of the United States, the species is found up the Mississippi River Valley to St. Louis, Missouri, and in southeastern Oklahoma (Correll and Correll 1975; Steyermark 1963). Up the Ohio River Valley, the species is considered extirpated in Indiana (Aldrich pers. comm.), and is recorded in 3 southern counties in West Virginia (Strausbaugh and Core 1977).

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APPENDIX

Other species at the Lancaster County site for *Ludwigia decurrens* are the following (nomenclature follows Kartesz and Kartesz 1980): *Acer saccharinum, Amaranthus graecizans, Ambrosia trifida, Ammannia coccinea, Calystegia sepium, Chenopodium ambrosioides, Cyperus aristatus, Cyperus difformis, Cyperus strigosus, Digitaria* sp., *Echinochloa crusgalli, Eclipta prostrata, Eragrostis capillaris, Euthamia graminifolia, Hibiscus laevis, Hypericum mutilum, Ludwigia alternifolia, Ludwigia palustris, Lythrum salicaria, Mimulus alatus, Mollugo verticillata, Penthorum sedoides, Phyla lanceolata,Phytolacca americana, Platanus occidentalis,Portulaca oleracea, Robinia pseudoacacia, Rorippa palustris, Rotala ramosior, Sagittaria* sp., *Salix* sp., *Scirpus pungens, Setaria faberi, Typha latifolia, Verbena hastata, Xanthium strumarium.*

Bartonia No. 54: 26–27, 1988

Early Botany in the Trans-Allegheny Region

A Symposium Organized By

EMANUEL D. RUDOLPH AND RONALD L. STUCKEY
Historical Section, Botanical Society of America, AIBS Meeting, Columbus, Ohio, 11 August 1987

INTRODUCTION

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Was there a distinctiveness in early nineteenth century botany and science as it was practiced in the trans-Allegheny region? Some of those who pursued the understanding of nature thought so.

The region is described by one author as follows: "In the Ohio Valley, embracing portions of Pennsylvania, Ohio, and Kentucky, as well as a long narrow wedge running across southern Indiana and Illinois into Missouri, we have something of a unit which constituted the first Middle West. Beyond it and above it, ever a stage behind in development to 1860, lay a second region, embracing the remainder of the Old Northwest and parts of Iowa and Minnesota. Together they formed a giant section equal in area to the original thirteen states. . . ." (Craven 1934, p. 43).

Scientific endeavors in the Colonies and early United States, according to most historians are pale reflections of European, particularly British, science (Greene 1984; Bruce 1987). Such activity was practiced by a population living mainly on the eastern seacoast in the larger cities, such as Philadelphia, Boston, New York, and Charlestown, where libraries, scientific societies, publication opportunities, and other resources were available to naturalists. No wonder that investigations by naturalists west of the Allegheny Mountains should be cast by historians as even dimmer reflections of Eastern United States and European type science, and thus warranting even less of their critical study. However, I believe there is a "Western" or "frontier" attitude reflected in naturalists that is more questioning and more assertive that is unique.

In this symposium we will learn about some aspects of botanical and other investigations in the Western areas of the new nation. A nation in which two hundred years ago Congress enacted the Northwest Ordinance establishing a pattern for governance of the lands north and west of the River Ohio and provided for the orderly development of new states, on an equal status with the existing ones. This liberal and foresighted attitude of the Federal Government provided a healthy optimism in settlers of these territories as well in those south of the Ohio River (Van Trees 1986). Such optimism is reflected in the itinerant and especially in the resident naturalists who collected and described plants, animals, fossils, Indian artifacts, and everything around them in these Western lands. Although they were few in number, and often worked in isolation because large cities with resources were lacking, though developing (Hendrickson 1976), they felt nature had provided ample novelty for their enthusiastic investigations. Mostly they collected specimens and described species, but some of them challenged the interpretations of the Eastern establishment.

Those were exciting times, and we will share, for a brief moment, some of that excitment and zeal. A zeal that combined scientific curiosity, patriotic devotion, regional pride, with a religious furvor for illuminating and admiring God's work. As Daniel Drake put it: "It is not the gratification of curiosity alone that delights us in studying the productions of the earth. The beneficent Creator has mercifully given us capacity for deriving pleasure even from the contemplation of those portions of his mighty works which immediately surround us, and with which we are most familiar." (Drake 1820, p. 92)

Several themes are apparent in these papers. The first one is that the naturalists involved, be they regional visitors or residents, had complicated networks of cooperating individuals which included East Coast foci in such people as Benjamin Smith Barton in Philadelphia, John Torrey in New York, and Asa Gray in Cambridge. The second theme is that collections of preserved natural history specimens by individuals and institutions in the region were preceived to be important manifestations of scientific achievement and were useful in public education. The third theme is that discovery of species new to science, finding useful organisms, and understanding the regional flora and fauna were the major stimuli for those who studied nature.

Aspects of our subject that appear to warrant further attention include an understanding of the importance of institutions, such as universities, schools, societies, and museums, in the development of science in the new West. Although science is universal in nature, were there particularly unique aspects of how science developed in the Trans-Allegheny region that might be considered unique? Because most of the early naturalists were earning their livelihood through non-scientific professions, how did new recruits become attracted to the scientific endeavor? Was there an additional group of unheralded educators who were envolved in that recruitment, or did the naturalists themselves recruit by example? Surely as more studies of the history of natural history are made these and other questions will find answers.

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SYMPOSIUM PAPERS

The following papers by Joseph Ewan, Henry D. Shapiro, Charles Boewe, Ronald L. Stuckey, and Relda Niederhofer are from the symposium on early botany in the trans-Allegheny region.

Bartonia No. 54: 28–38, 1988

Benjamin Smith Barton's Influence on Trans-Allegheny Natural History

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Corridors have dictated history. They are the breakthroughs. For example, the Yukon corridor enabled the Asians to enter America—plants, animals, and people. Then, too, corridors through the Sierra Nevada of California in the 1840's opened not only an Eldorado of gold, but led to the discovery of the Sequoias, largest trees on earth. So it was that through the corridors of the Allegheny and Appalachian mountains flowed discovery and information formulated back in that "hotbed of the sciences," Philadelphia, between 1790 and 1815, in part because of a naturalist-physician-professor, Benjamin Smith Barton, a native of Lancaster, Pennsylvania.

Barton had accompanied his uncle, David Rittenhouse, on the survey of the western boundary of the state in 1785—Barton was then nineteen. He saw the Ohio River, live Indians, and an Indian mound that was to excite his lifetime interest in the origins and

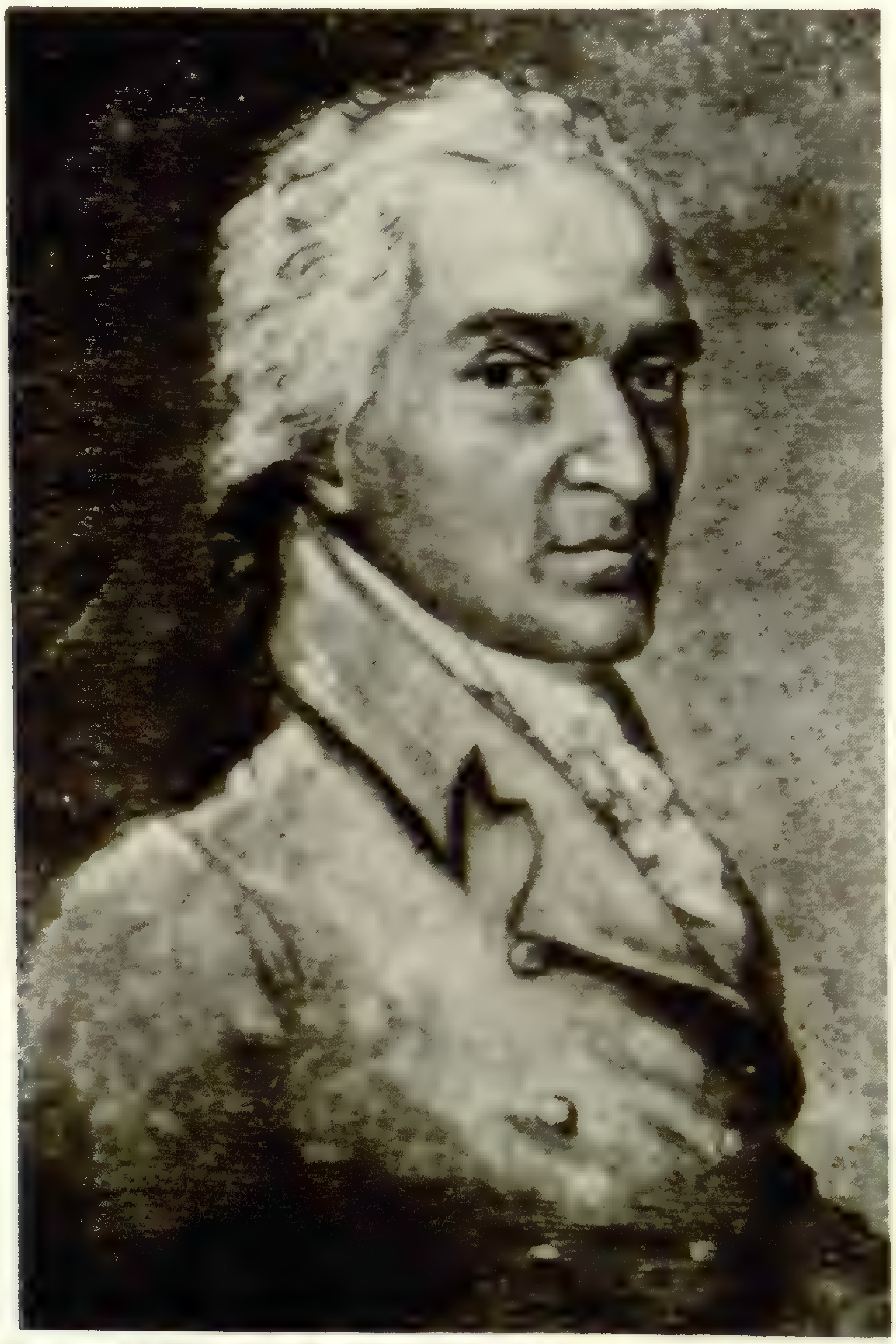

FIG. 1. Benjamin Smith Barton (1766–1815). The original portrait is an aquatint by Bass Otis (1784–1861) of Bridgeport, Massachusetts, who came to Philadelphia in 1812. Reproduced from Joseph Ewan (1983), "From Calcutta and New Orleans, or, Tales from Barton's greenhouse," Proc. Amer. Philos. Soc. 127: 125–134.

languages of early Man in America. Later Barton instructed medical students in the nation's leading medical school in its largest city. From the contacts Barton enjoyed with Thomas Jefferson and his 126 medical pupils, we may trace his influence on the growth of the natural sciences through and beyond the Allegheny and Appalachian corridors.[1]

What had prompted Barton's interest in the trans-montane floras and faunas? First there was the challenging premise of Buffon and Rev. William Robertson that American life-forms were smaller, weaker, and inferior to their Old-World counter-parts. What was the evidence? Jefferson had mentioned the issue in his questionnaire called *Notes on the State of Virginia* in 1784.[2] When Humboldt visited Philadelphia in 1804, Barton presented his observation that different patterns of plant distribution obtained east and west of the Alleghenies, and published on the subject in 1807.[3] Humboldt cited Barton's thesis of different patterns in his *De Distributione geographica plantarum* [Paris,] 1817.[4] This was the first phytogeographic commentary to use broad conclusions provided by an American botanist. Barton had wondered why the Indian mounds or tumuli were more numerous west than east of the mountains. These mounds had been of interest to Barton since he first visited them in 1785.

Partly stimulated by Michaux's publication of North American plant records, Barton had supported Frederick Pursh in his botanizing in Virginia and New York states. Pursh, however, had not collected in the Ohio River Valley. Barton was to send Thomas Nuttall to record what grew in the "Northwest Territory" of that day.[5] Yet Barton knew that resident observers were in a better position to learn the biology of a species, plant or animal, than a passing naturalist. The seedling stages of the plant, flowering dates among related species, pollination, and, particularly the names and uses of plants by the arborigines and the settlers—all were topics repeated in his abundant letters. His graduates, living in Ohio or Kentucky, would furnish, he hoped, the information he sought, which, even in an imperfect state, he hoped to put into print.

Barton's nephew, William P. C. Barton, commented that the medical graduates "were scattered annually, through different sections of the United States [and that] many of them cherished the love for botanick pursuits which they had imbibed [at the University]—they became botanists. And thus have the exertions of the Professor been seen and felt, *beyond* the precincts of the University."[6]

In 1807 Barton posed a typical question at a meeting of the Philadelphia Linnean Society: "I am not certain," he admitted, "whether the Buffaloe-Clover is a species distinct from the White Clover, or *Trifolium repens*. On the Ohio, where I have seen it, this plant grows to a great size, on which account, and because it constitutes so large a share of the food of the Buffaloe (*Bos Americanus*) it has received the name of Buffaloe Clover."[7]

Before Barton, however, John Bartram had been in Fort Pitt with Col. Henry Bouquet in 1761. We do not know the details of the seeds and plants Bartram received then from Col. Bouquet, who had an interest in plant lore, but evidently pecan nuts were in his baggage.[8] George Rogers Clark in 1783 sent Jefferson "peccan" seeds. As with the pinyon nuts among the Colorado tribes, the pecan was an article of barter with the eastern Indians beyond Illinois, and so the original range of the tree remains uncertain.[9] What Humphry Marshall called *Juglans pecan* in his "American Grove" was a well known food before 1785.[10]

Perhaps it was Col. Bouquet who provided the seeds of the Bitter gourd, or African cucumber, from the Illinois River country. It was grown by the informed gardener, James Alexander, at the seat of Thomas Penn. William Bartram, thanks to James Alexander, was given a fresh sample and he made a most decorative drawing of it, *Momordica charantia*.[11] The Bitter gourd, presumably of west African origin, had been carried to the West Indies by slaves. Very possibly from its attractive red-seeded fruits for the cooking pot or for magic uses, it was transplanted again to our southern ports, and thence riverbound to Illinois country.

Among the 126 medical pupils of Barton three were associated with William Dunbar in the river town of Natchez to whom he conveyed Barton's interests.[12] A native of Scotland, William Dunbar (1749–1810) came to American before the revolution, traded in timber and indigo in Baton Rouge from 1774 before moving to his plantation near Natchez in 1783. Dunbar was an all-around naturalist, making astronomical sightings, keeping weather records, hosting Alexander Wilson, and corresponding with Jefferson and Rev. Henry Muhlenberg. Dunbar told Muhlenberg of Lancaster, Pennsylvania, that managing a plantation and supervising slaves left little time for botany.[13] It may have been on Dunbar's advice that Frederick Seip enrolled in Barton's classes. Seip took his M.D. degree in 1800—his thesis was "Cataracts," and he returned to Natchez to serve as physician to Dunbar's establishment. Whatever the exchange of letters, we know that Barton wrote Dunbar first of March 1801, requesting a list of local mammals, and that Dunbar responded. Barton characteristically published the content of Dunbar's letter in his Philadelphia Medical and Physical Journal.[14] It included General Wilkinson's report of a huge "panther" taken in the Upper Rio Grande Valley.

Dr. Seip later wrote Barton that it would "afford me extreme pleasure to procure every information that lies in my power," and that he would "forward some specimens likewise," though the waters of the Mississippi "being now at their height will preclude the possibility for a few weeks," but he would "immediately make every effort to obtain on their subsideing." He closed his letter with his best wishes for Barton's "health and happiness," a frequent concern of his pupils.[15] Dunbar told Muhlenberg "we must continue in ignorance until some expert botanist visits and spends a season in our country."[16] Dunbar may have joined Dr. Seip in urging Garrett Elliott Pendergrast to study under Barton. Pendergrast took as his thesis a topographic survey of Mississippi Territory and its diseases with an M.D. Degree in 1803.[17] In 1812 he was appointed hospital surgeon at Plattsburg, an army camp south of the Natchez Trace. From there he tendered his respects to Barton, and hoped in the coming spring of 1814 to visit a "rattlesnake den near this place of which the inhabitants give such wonderful accounts. They confirm the extraordinary, and I once thought, incredible narrative of Chateau Bryan—a man in this vicinity, annually makes one or two hundred dollars by killing and selling this serpent. He decoys them into his power with the inchanting notes of a flute. But I shall visit the den with this modern land syren, I decline expatiating at present." Dr. Pendergrast added as a postscript that he hoped to prepare some remarks on the diseases of the army to the medical society in Philadelphia, "the city to which I owe my education."[18]

Some years before Dr. Pendergrast had been suggested by Wistar or Jefferson to be naturalist on Thomas Freeman's military reconnaisance of the Red River. It was Barton, however, who finally decided in favor of another pupil, then in residence for his degree, Peter Custis of Virginia.

Meanwhile in October 1805 President Jefferson sent Barton collections from the Washita expedition taken by Dr. George Hunter—supplies had been given Hunter from Dunbar's plantation.[19] Jefferson wrote Barton, "I know I cannot dispose of [the specimens] better than by transmitting them to you, with a request of the result of the investigation. The Washita expedition of 1805, as with the Lewis and Clark to the Pacific, had been designed to determine the western limits of the Louisiana Purchase, with the added design of apprehending the Spanish intentions in the Southwest. Jefferson fielded a surreptitious follow-up survey, which would be called the ''failed expedition.'' Barton's pupil Peter Custis, whose medical career at the University of Pennsylvania would be interrupted by his appointment to accompany Thomas Freeman as naturalist, received his letter of appointment on January 14, 1806. Three days later Custis left Philadelphia for Natchez, with the promise of a salary of three dollars a day and expenses, his additional instructions in natural history to come from William Dunbar.[20]

In his fullsome letter from Natchitoches, Louisiana, dated June 1, Custis[21] told his mentor Barton how the party after delays entered the mouth of the Red River on the Mississippi sixty miles below Natchez, where the Red River was ''about a half mile wide.'' The river soon narrowed and annually flooded its fringing forests. Custis reported that the Pasquagoula Indians, inhabiting both banks, appeared to be ''peaceable, industrious and friendly people.'' The soil, he added, supports ''the best cotton land in the world.'' Trees he noticed, and ''the Pecan (Juglans petiolata, as I have called it) is everywhere on this River abundant.'' He reported ''the Alligators [to be] very abundant and of very large size—the largest I have had an opportunity of measuring was 12 feet long.'' Snapping turtle (*Testudo ferox*) is 18 inches long, 15 inches wide; Alligator gar (*Lepisosteus spatula* Lacépède) 15 feet long; and the giant salamander which Custis called ''*Syren quadrupeda*'' which he likened to *Siren lacertina* but with four legs. This specimen measured 3 feet, 6 inches, and was 6 inches in circumference. Today it is familiar to Louisianan naturalists as the Congo eel.[22] Custis said that ''had it not been in a very advanced state of putrefaction I should have preserved it & sent it on.''

We glimpse a rising curtain of drama as we read ''Tomorrow morning we leave [this river port] with 7 boats, 40 men, 3 commissioned & 4 non commissioned officers. It is expected that the Spaniards will endeavor to stop us—They are reinforcing at Nachiodoches [Texas] 150 miles from this [place], for what purpose it is not known.''[23] Indeed, the Freeman-Custis expedition was turned back by the Spaniards. Historian Flores has documented the misfortunes of Custis in winning his deserved credit for his Red River collections and their identifications.[24]

The last and only other letter of Peter Custis so far recovered was addressed to Barton from Drummond Town, Virginia. In it Custis relates his intention to relocate his medical practice; requests ''vaccine virus'' by the first mail; and suggests that he may be able to collect a debt on Barton's behalf incurred by another pupil, commenting that the pupil has ''lately married a girl with some property.'' Into this letter he sweeps some range extension notes on Spanish moss, which, Custis says, may grow as far north as Maryland, along with the live oak, *Quercus virginiana*. He will, he writes, send specimens of ''all our plants.''[25]

The botanical contribution which Thomas Russell might have made was aborted. Born in Salem, Massachusetts, in 1793, he attended Brown University, likely when Dr. Solomon Drowne beginning in 1811 taught materia medica and botany there. Russell then enrolled at University of Pennsylvania taking courses under Barton, John Redman Coxe, and Caspar Wistar, his M.D. degree in 1814. By that date printed theses were no longer required, and so we do not know his subject. We find Dr. Russell next as post surgeon at Fort Smith, Arkansas. Nuttall made the post his depot for natural history of the territory in 1819.[26] He had the "friendly aid and kind participation of Dr. Russel, whose memory I have faintly endeavoured to commemorate in the specific name of a beautiful species of Monarda." They talked, no doubt, of their years with Barton. Four months after Nuttall's visit Dr. Russell died of a fever. He was 26. No Russell letters have been recovered.

Although Thomas Nuttall was not Barton's medical pupil, and the Indian tribes of the Arkansas River country called him "the pale-face medicine man," he had been Barton's protége. Nuttall carried Barton's personal endorsement—"a native of England, brought up in a manner under my own eyes and implantings, and distinguished by his love of science, his integrity, his sobriety [Barton had put up with Pursh] and innocence of character. Barton underscored "innocence." This endorsement to "His Excellency William Harrison, Governor of the Indiana Territory at Fort Vincennes," was the first of repeated letters enlisting passports for Nuttall to enter British soil. The second letter, April 8, 1810, to chief Justice of the Territory of Michigan, Augustus B. Woodward, was carried by Nuttall and presented at Detroit 79 days later.[27] Justice Woodward wrote Barton on June 29th that he had given Nuttall "his sentiments very freely as to the best means of prosecuting his route to Lake Guinipique," and then spent most of the long letter for Barton's benefit discussing the Wyandot language and its resemblance to Greek, especially the dual verb as well as singular and plural forms. He had found that there were nearly 1000 verbs in the Wyandot language! After two and a half pages his farewell was "the mail is closing."[28]

Nuttall encountered reports of hostile feelings between Americans and British when he reached Michilimackinac, and so he was persuaded to join the Astoria party bound for St. Louis. Altogether Nuttall spent six months at St. Louis with collecting trips in the vicinity, especially for minerals. There is no evidence that he wrote a single letter to Barton from St. Louis, or later on the trip up the Missouri, or from New Orleans before returning to England—could letters have been lost enroute, or had Barton written disapproval of the change of plans? Nuttall mailed "a number of dried specimens and seeds which he had collected" for Barton, and a "ms. book," according to his nephew, W. P. C. Barton. The lack of letters is a curious anomaly since there are four letters in Barton's correspondence dating from June 16, 1809, to April 22, 1810, including two from Wilkesbarre and Pittsburgh.[29] Although Barton's financial support was necessarily scarcely generous, he influenced Nuttall's progress deeply.[30] That is hardly evident in the autobiographical preface which Nuttall left in his *North American Sylva* (1842) where he does not mention him.[31] Despite the sympathetic scrutiny of Nuttall by Graustein and Beidleman in particular, the early life of Nuttall leaves unanswered queries for future historians.[32]

Reuben Dimond Mussey was Barton's pupil during Nuttall's years in Philadelphia although Mussey's contacts with Nuttall, if any, are unrecorded.[33] Mussey won his M.D. degree in 1809. Between 1838 and 1852 he taught courses at the Miami Medical College in Ohio, retiring at the age of 72. During these years he collected shells which went to the National Institute with his catalog of the shells of the Ohio Valley (1843). Nuttall had also collected shells on his travels—he took what proved to be an undescribed shell while bird watching on the Salem beach in Massachusetts—and two genera, a chiton and a bibalve, bear his name, in addition to at least nine species of molluscs.[34]

Although Samuel Prescott Hildreth (1783–1863), M.D., was not a medical pupil of

Barton he was among his large roster of correspondents. After receiving "several specimens of minerals" including bismuth, Barton wrote in 1810 to Hildreth asking that he give all the information he could concerning bismuth. "Are you confident," asked Barton, "it came from Ohio, if so, what district of Ohio," and the nature of the soil in the vicinity of the bismuth. Barton asked for a larger sample, remarking that bismuth is so important a mineral in the composition of tipe [sic] metal that the owners of the property "are indeed rich." In this same letter Barton requested plants from the vicinity of Marietta which "must be interesting," and "seeds of some of your more curious, beautiful or useful plants." Barton closed his letter: "I beg you, Sir, to command my services."[35]

Dr. Hildreth had come from New England to Marietta, Ohio, in 1806. Stuckey tells us that he was the first resident physician in the Ohio valley who had an interest in botany, assembling an herbarium of the plants of the environs of Marietta. He practiced medicine for 55 years, but found time to collect shells as well as plants. He prepared a catalogue of the freshwater shells found near Marietta, and sent conchological papers to Silliman's *American Journal of Science and Arts.* He visited fossil plant localities in the Mahoning Valley in company with Jared Kirtland, a Barton pupil.[36]

Jared Potter Kirtland (1793–1877) was ten years old when his father and mother moved from old to New Connecticut, leaving him with his maternal grandfather, Jared Potter, in Wallingford.[37] Dr. Potter was a decisive influence in his grandson's lifework. He was a gardener, a friend of Eli Ives of Yale who was professor of botany and materia medica there, and who had been a student of Barton.[38] Important for Kirtland, too, was Dr. Potter's meticulous keeping of records. When Jared was twelve he was identifying the local plants using the Linnaean scheme that Ives, and before him, Barton, had used in classification. It is reported that Eli Ives had established a botanic garden (no doubt for teaching materia medica classes) with his own monies. Incidently, Frederick Pursh, long after his years with Barton, had been solicited to superintend the botanic garden because of his association with Barton, Bernard M'Mahon, and other plantsmen in Philadelphia. But Pursh declined and instead joined Lord Selkirk's aborted Red River Valley Settlement.[37]

To return to Kirtland, by 1810 grandfather Potter and cousins were raising silkworms, and it was in that connection that Jared Kirtland demonstrated parthenogenesis. It would be 1856, however, before K. T. E. von Siebold (1804–1885) published on parthenogenesis.[39] Jared inherited his grandfather's medical books, entered Yale medical school, and took private instruction in botany with Professor Ives, but his health broke. For a change of scenery Jared enrolled in Barton's class in 1814 and prepared a thesis entitled "our indigenous materia medica." Details are lacking on the circumstances, but Kirtland did not take his degree at Pennsylvania—Barton, never in good health, was preparing for his sojourn in Europe the following year, and so Kirtland returned to Yale and graduated M.D. in 1815.

Without doubt grandfather Potter, botanist Ives, and Barton, all influenced Kirtland and set off the broad natural history interests which marked his long life. His Ohio career is familiar: Ohio Geological Survey from 1837, first president of the Cleveland Horticultural Society in 1844, and his successful hybridizing of cherries—he was known as the "Cherry King." His keen interest in conchology—said Kirtland, "Isaac Lea is multifplying new species out of the most trivial varieties at his usual rate"—with Louis Agassiz concurring with Kirtland's estimate. And there was his advocacy of Thomas Hart Benton and John C. Fremont. There was also his close friendship with

Spencer Fullerton Baird of the Smithsonian.[40] They made several field trips together in July 1853 in company with Dr. Philo R. Hoy, M.D. of Racine, Wisconsin. A new garter snake found on this trip was named for the cooperative city of Racine, *Eutaenia radix*. At Madison the city's flour mills was stopped by order of Governor Fairchild so that the party could seine below the mill, with excellent results. Kirtland and Baird found the mollusca fauna of Ohio declining in 1851, commenting that in the past decade molluscs in the Cayahoga River, then plentiful, were now nearly or quite extinct. Spencer Baird believed that "In another generation many of our finest [mollusca] will cease to be known except in books and cabinets" due to discharge from factories and foraging hogs.[41]

Dr. Kirtland published the first checklist of Ohio birds in 1838, and for the next thirty years entered marginalia in his copy of Nuttall's *Manual of Ornithology* (1832–1834). The celebrated Kirtland warbler was collected by Charles Pease, in his father-in-law's orchard in what is now the city of Lakewood, Ohio, on May 13, 1851.[42] It was at the height of the warbler migration on Lake Erie. Pease, believing the bird to be unusual showed it to Kirtland's house guest at the time, Professor Baird, who made up the skin. Back at Smithsonian where he was "Keeper of the cabinet" Baird determined it to be an undescribed warbler and named it for his friend. For 27 years the warbler was not seen again until it was apprehended (and "collected") in the Bahamas. Another 25 years passed before its nesting tract was discovered in Michigan. Today Kirtland's warbler is so rare that few bird watchers will see it in their lifetime. That the bird travels a narrow path nearly 1400 miles from the jack-pine plains of Michigan to its island spa in the Bahamas is testimony of the fragile world we share.[43]

Daniel Drake (1785–1852), "Physician to the West," at twenty years of age came to enter the medical school in Philadelphia. Greatly impressed by Rush's presence and prestige as an intellectual leader, and under his influence, Drake unfortunately became "a strenuous advocate of sanguineous depletion." From Barton, however, he gained his wider perspective of the natural universe and his development of critical observation.[44] Having grown up almost illiterate in a log cabin near May's Lick, Kentucky, he moved to Cincinnati to become the apprentice of Dr. William Goforth whose partner he became. He found his task of grinding mercury into mercury ointment "hardly different from grinding corn in the handmill."[45] In October of 1805 he entered the University of Pennsylvania able to pay only Professors Rush, Woodhouse, Wistar and Physick for classes. He was even unable to pay for a ticket to the hopital library, so that he had to borrow books in off hours from fellow students, and from Dr. Dewees and Dr. Barton who "were very kind to me in this way."[46] Barton also permitted him to attend his lectures without fee, and Mrs. Barton took a motherly interest. Unable to finance completion of his degree Drake returned to practice in Cincinnati, but again entered medical school and obtained his degree in 1815.

Drake contributed his first essay on July 22, 1807, to Barton's Philadelphia Medical and Physical Journal, "Some account of the epidemic diseases which prevail at Mays-Lick in Kentucky."[47] He shared Barton's interest in Indian mounds and their origins. Drake's floral calendar appears to be an extension of Barton's phenological interest manifested in Fragments (1799), the corollaries of migration of birds with flowering periods. In this Barton had utilized William Bartram's with his own. Drake's interest in the uses of Colombo root (Frasera verticillata) bears witness of his familiarity with Barton's essays. Barton mentioned Drake regarding the use of *Digitalis* in *Cullen's Treatise* (1812): "I advise my young readers . . . to read with attention, what has been written upon the subject by Dr. Drake,'' and the poor response to its use for consumption.

Drake's Cincinnati residence brought many visitors: Thomas Nuttall in the summer of 1816, and another Barton protegé, William Baldwin (M.D. 1807) westbound on the Stephen Long expedition in May 1819.[48] In historical perspective Drake's *Systematic Treatise* of 1850 was reminiscent of those promotional tracts of Virginia two hundred years before, representing inventories of the prevailing medical and social practices. In the final decades of the nineteenth century they would be called ''The Natural Resources of———.'' ''Like Rush, Drake had many irons in the fire, which in more respects than one, were constantly kept in an incandescent state.''[49] So wrote Dr. Samuel D. Gross. The same might be said of Barton.

Drake, son of a poor farmer who had moved two years before, contrasts with Charles Wilkins Short (1794–1863), the son of a prosperous owner of a large Blue-Grass farm near Louisville.[50] Charles graduated from Transylvania University at sixteen, entered the University of Pennsylvania medical school at nineteen, and after two years instruction under doctors Caspar Wistar and Barton, graduated M.D., 1815. Unfortunately Charles Short was Barton's pupil during his professor's later difficult years. Details of their association are lacking, but Short's thesis topic, the medical properties of *Juniperus sabina,* suggest Barton's influence. When Dr. Short was teaching materia medica at Transylvania in 1833 in his introductory address several episodes that read like pure Barton. In 1845 Short gave the prep talk to the gentlemen just assembled for the fall session at the Medical Institute of Louisville. He recalled the ''Green Room'' a screen of green baize at the University of Pennsylvania enclosing the candidate at his final oral final examination. Short bridged the Linnaean century, espoused by Barton and Nuttall, diffidently to be sure, and the innovations of Torrey and Gray whose monumental works he supported. Short lived just four years after Darwin's *Origin* rewrote Genesis.

James Chew Johnston was born in a log house in Louisville, 31 July 1787, the grandson of a physician. He grew up on the family plantation Cave Hill, attended the College of New Jersey (Princeton University) and moved to Philadelphia to become the medical pupil of Barton. His thesis on the nourishment of the foetus led to his degree in 1810. He wrote to Barton on September 16, 1810, that he was sending some plants collected in the vicinity of Louisville, but no specimens have been located. His biographer says Johnston cultivated his interests in gardening and agriculture and was ''perhaps the best educated of his contemporaries in the profession.'' He was a founder of the Louisville Medical Society.[51]

Thomas Duché Mitchell enrolled in Barton's class for materia medica in 1809—his admission card survives—but he took his degree under Benjamin Rush on medical chemistry (M.D., 1812). Rush mentioned Dr. Mitchell in his ''Defence of Bloodletting,''[52] so Mitchell evidently opposed Barton on that practice. Mitchell became associated with both Miami and Transylvania universities.

Barton's life-span, only forty nine years, ended in 1815. His influence, filigree-like, reached into the Nineteenth Century, in direct ways through his pupils residing in the ''West'' of that era. Indirectly it was through Barton's associates, such as William Maclure with whom in 1796 he travelled and observed, and who was an important tool in the building of that memorable experiment of scientists on the Wabash, the New Harmony movement.[53]

That was after Barton's time, but not beyond his early influence. Barton wrote in

1793,[54] "My book will be accompanied with a plate [of the tumuli at Muskingum] . . . the book goes to press on Monday next. However, it will proceed but slowly, for some time at least."

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NOTES

1. Barton once declared he lectured in one year to over 250 pupils. The Roll book in the University of Pennsylvania Archives and the printed theses show 126 medical pupils.
2. Buffon's thesis is developed in Rev. William Robertson, *History of America* (Cork, 1877) 1: 259–263. Jefferson, *Notes,* William Paden ed. (Chapel Hill, 1955) 63–65. Barton, on May 26, 1793, wrote to Joseph Banks on the "antiquity of the American world" (Add. mss. 8098, British Library.).
3. *Discourse . . . in Natural History* (Philadelphia, 1807) 64.
4. Humboldt, *De Distributione,* 76.
5. Pursh drew up a "Prospectus" for a collecting expedition to New Mexico with Thomas Nuttall! See *Huntia* 3(1979) 83–86.
6. William P. C. Barton, *Florae Philadelphicae Prodromus* (Philadelphia, 1815) preface, p. i.
7. *Discourse . . . in Natural History* (Philadelphia, 1807) 84. *Trifolium pennsylvanicum* Willd., *Enum. Hort. Berl.* 793. 1980 may related to this form of *T. repens?*
8. Edmund and Dorothy Smith Berkeley, *Life and Travels of John Bartram* (Tallahassee, 1982) 198.
9. See C. S. Sargent. *Bot. Gaz.* 66 (1918) 230–231.
10. Humphry Marshall, *Arbustum americanum* (Philadelphia, 1785) 69.
11. William Bartram's drawing of *Momordica charantia* reproduced in J. Ewan, *William Bartram, Botanical and Zoological Drawings, 1756–1788* (Amer. Philos. Soc., Philadelphia, 1968) plate 14, text p. 54.
12. Alexander Wilson (1766–1813) was Dunbar's guest at "The Forest" on May 23, 1810 (George Ord, "Life of Wilson" in A. Wilson and C. L. Bonaparte, *American Ornithology* (Phila., 1871) pp. c–ci. Dunbar was a subscriber to Wilson's *American Ornithology* (Robert Cantwell, *Alexander Wilson* (Phila., 1961) 287.
13. "I am but a poor Botanist; I am, it is true, acquainted by reading with the Linnaean System &c, but this conveys merely a theoretic not a practical knowledge. Great part of my life has been employed in . . . agriculture . . . and my evenings only could be dedicated to study." W. Dunbar, Natchez, April 15, 1806, to H. Muhlenberg. rec'd June 18, 1806. Hist. Soc. Pa. Samuel Postlewaite (1772–1825), leading Natchez merchant, provides a portrait of the Dunbar home (see "Journal from Louisville to Natchez, 1800" *Mo. Hist. Soc. Bull.* 7(1951)294–295, 312–329).
14. *Phila. Med. and Physical Jour.* 2 (sect. 3)(1805)160 and 177.
15. F. Seip, Natchez, May 16, 1807, to Barton. Barton papers, Am. Philos. Soc.
16. W. Dunbar, undated letter, incomplete, to H. Muhlenberg. Histo. Soc. Pa.
17. Garrett Elliott Pendergrast (1776–1850), born Harrodsburg, Mercer Co., Ky., son of a Revolutionary Ward soldier, pupil at Transylvania Seminary, merchant at Natchez and practicing physician there and later in Louisville after 1822. Served as surgeon in War of 1812 with battalion of Orleans volunteers (C. E. Carter, *Terr. Papers of the U.S.* 5(1937)263, 9(1940)718. Eugene H. Conner, *Bull. Jefferson Co. Med. Soc.* 14(1966)29–38.).
18. G. E. Pendergrast, Plattsburg, Miss., Jan. 1, 1814, to Barton. Barton papers, Am. Philos. Soc. See Laurence Klauber, *Rattle-snakes* (Univ. Calif., Berkeley, 1956) 398–400, 547, on their dens. Pendergrast's thesis (1803) has exceptional regional merit for reprinting for its notice of Dunbar, p. 27, and trees, 20–22, etc. He was a member of Barton's American Linnean Society.
19. For George Hunter references see Max Meisel, *Bibliography of American Natural History* 2:86–88, and J. F. McDermott, *Trans. Am. Philos. Soc.* 53(pt 4) (1963)1–133.

20. Only ten copies of Peter Custis, *An Account of the Red River in Louisiana* have been located in libraries. Dan L. Flores, *Jefferson and Southwestern Exploration. Freeman and Custis Accounts of Red River Expedition of 1806* (Univ. Okla., 1984) and supplement, *Southwestern Historical Quart.* 88(1984)1–42, offer extensive commentary.
21. P. Custis, Natchitoches, La., June 1, 1806, to Barton. Barton papers, Am. Philos. Soc.
22. *Amphiuma tridactyla* Cuvier, named in 1827, is a large, eel-like, aquatic salamander, called Congo eel, with four very small legs each leg three-toed. Flores (1984), 226, provides a good photograph. There is support for the scientific name *Amphiuma quadrupeda* (Custis).
23. Custis' letter to Barton was published in his Phila. Med. Phys. Jour. 2 (pt. 2) (Sept. 26, 1806) 43–50, The *Journal* enjoyed only limited circulation.
24. Flores (1984), 41–42, enumerates the Custis discoveries, including the beautiful gentianaceous *Eustoma* named by Rafinesque who, with exceptional oversight, missed the Custis publication.
25. P. Custis, Drummond Town, Va., May 21, 1807, to Barton. "answered." Barton papers, Am. Philos. Soc. Drummond Town is the former name of Accomack Court House on the peninsula, now Accomac, Accomack Co. (Lippincott, *Gazetteer*, Philadelphia, 1856).
26. T. Nuttall, *Journal of Travels into the Arkansas Territory during the year 1819*. Savoie Lottinville, ed. (Univ. Okla., 1980) 156. As Lottinville comments, 220, Nuttall surely knew Barton's *New Views* (1797) where the Asiatic origin of American tribes is propounded, yet Nuttall does not mention Barton in the 296 pages of his *Travels*.
27. Barton, Feb. 13, 1810, to "Gov. William Harrison." Barton papers, Am. Philos. Soc. William Henry Harrison, 1773–1841, ninth president of the United States, authored "A Discourse on the Aborigines of the Valley of the Ohio." (1839). Sabin 30571.
28. A. B. Woodward, City of Detroit, June 29, 1810, to Barton. Barton papers, Am. Philos. Soc. Judge Augustis Brevoort Woodward (1774–1827), Jefferson's appointment, created a plan for the "University of Michigania," the fillip for the University of today. See W. L. Jenks in *Dict. Am. Biog.* Nuttall's discoveries on his trip of 1810 are detailed in R. L. Stuckey, *Michigan Botanist* 6(1967)82.
29. It is possible Barton wrote to Nuttall at St. Louis when he learned of his changed itinerary but any record is missing. How did Nuttall support himself for six months in St. Louis? Perhaps the newsprint *Missouri Gazette* may reward a search? John Bradbury's activities are better documented: he kept a growing garden three miles from St. Louis, collected sixty species of birds for Lord Derby, 13th Earl, etc. There existed a publicized wall between Nuttall and Bradbury; for example, Bradbury wrote two letters to William Roscoe of Liverpool without mentioning Nuttall, though Nuttall was well known there. Manuel Lisa owned a library and might have been a source of information but from J. F. McDermott, *Private Libraries in Creole Saint Louis*, Baltimore, 1938, 107, did not feature natural history.
30. William P. C. Barton, "A Biographical Sketch of Professor Barton," 1816, and reprinted in *Elements of Botany* Phila., 1836. see p. 27.
31. Nuttall, *North American Sylva* (1842) reissued to Rich, Rutter, Philadelphia edition of 1865. See Ian MacPhail, *Sterling Morton Library Bibliog. in Bot. and Hort.* 2 (1983) 1–35.
32. Where is the letter dated Sutton, Lancashire, Feb. 24, 1813, to Barton, mentioned by F. W. Pennell, *Bartonia* 18 (1936) 50?
33. Reuben Diamond Mussey (1780–1866), M.D., vegetarian, temperance advocate, amateur conchologist (*American Malacologists*, Falls Church, Va., 1973, 136). Samuel D. Gross, M.D., wrote about Dr. Mussey from personal acquaintance (*Autobiography*, Phila., 1887, 2: 312–319).
34. *Amer. Malacologists* (Falls Church, Va., 1973) 138. J. E. Graustein, *Thomas Nuttall, Naturalist* (Harvard, 1967) 323.
35. Barton, Sept. 24, 1810, to S. P. Hildreth. Barton papers, Am. Philos. Soc. For geological note see George P. Merrill, *First One Hundred Years of American Geology* (Yale, 1924) 170–171.
36. See Max Meisel, *Bibliog. Amer. Natural History* 3:596. Also *Amer. Malacologists* (Falls Church, Va., 1973) 115. Ronald L. Stuckey, Some pioneer botanists of northeastern Ohio. Holden Arboretum, Mentor, Ohio, symposium. Typewritten, 4 pp.
37. Ronald L. Stuckey provided a list of 23 titles in June, 1982. Notable references: Agnes R. Gehr, *Explorer* (Cleveland Museum of Natural History) 2 (no. 7) (1952) 1–33, but see Walter B. Hendrickson, *The Arkites* (Western Reserve Univ. Press, Cleveland, 1962) 10–16, 48. Also G. E. Gifford, Jr., Dr. Jared Kirtland and his warbler. *New England Jour. Med.* 287 (1972)909–911, with 17 refs.
38. Eli Ives (1779–1861) overlooked since he left only incidental publications but for his long life as a botanical observer, he deserves scrutiny. Nine letters in Collins correspondence, 1817–1819, at Acad. Natural Sciences, Philadelphia. For Ives-Pursh relations, see Ewan, *Proc. Am. Philos. Soc.* 96 (1952) 599–628.

39. See Harry B. Weiss, *Pioneer Century of American Entomology* (privately published, New Brunswick, N.J., 1936) 191. For Karl Theodor Ernst von Siebold (1804–1885) see Pamela Gilbert, *Compendium of biographical literature on deceased entomologists* (Brit. Museum (Nat. Hist.) 1977) 352.
40. Kirtland mentioned in Elmer C. Herber, *Correspondence between Spencer Fullerton Baird and Louis Agassiz* (Washington, 1963) 72–73. Also William H. Dall, *Spencer Fullerton Baird* (Philadelphia, 1915) 182, 253–254, 285.
41. Dall, *Baird,* 254.
42. Kirtland's warbler, now *Dendroica kirtlandi,* described as *Sylvicola kirtlandi* Baird, *Ann. Lyceum New York* 5(1852) 217. pl. 6. Kirtland's owl, *Nyctala kirtlandi,* published in *Proc. Acad. Nat. Sci. Phila.* 6 (1852) 210, by Philo Romayne Hoy (1816–1892) is lost in the thicket of synonomy. The rattlesnake *Crotalophorus kirtlandi* Holbrook, was described in 1842 from Kirtland's collection of 1810. George Myers mentions the silverside genus *Kirtlandia* (Copeia 1964:41) without further detail.
43. The nesting area of Kirtland's warbler is mapped in Josselyn van Tyne and A. J. Berger, *Fundamentals of Ornithology* (Wiley, N.Y., 1959) 172.
44. Henry D. Shapiro, *Physician to the West. Selected writings of Daniel Drake on science and society.* H. D. Shapiro and Zane L. Miller, editors. (Lexington, 1970) p. xiv.
45. James T. Flexner. *Doctors on Horseback* (New York, 1944) 161.
46. Mary Louise Marshall. Versatile genius of Dr. Drake. *Bull. Medical Library Assoc.* 31(1943) 291–318. p. 294.
47. Daniel Drake. *Phila. Med. Phys. Jour.* 3 (pt. 1.) (1808) 85–90.
48. For a chronology of William Baldwin see William Darlington, *Reliquiae Baldwinianae.* (Classica Botanica Americana, suppl. II. Hafner, N.Y., 1969) l-lxix, see xiii-xxv.
49. S. D. Gross. *Histo. Amer. Med. Literature* (Phila., 1876) 26. See his personal anecdotal essay on Drake in his *Autobiography* (Phila., 1887) 2: 261–274.
50. See Ronald L. Stuckey, *Scientific publications of Charles Wilkins Short* (Arno Press, N.Y., 1978) i-v. Also 266–269 in Medical Botany in the Ohio Valley, 1800–1850. *Trans. & Stud. College Physicians of Philadelphia* 45(1978) 262–279.
51. James Chew Johnston (1787–1864) was the first Louisville physician to hold a medical degree (Eugene H. Conner, *Bull. Jefferson Co. Med. Soc.* 13 no. 3 (1965) 19; 14 no. 5 (1966) 30; 15 no. 7 (1967) 14; 15 no. 8 (1967) 36–37.
52. L. H. Butterfield, *Letters of Benjamin Rush.* Memoirs Am. Philos. Soc. 30 (1951) 760.
53. C. A. Browne, Some relations of the New Harmony movement to the history of science in America. *Sci. Monthly* 42 (1936) 483–497, is a notable commentary.
54. William Parker Cutler and Julia Perkins Cutler, *Life of Rev. Manasseh Cutler* (Cincinnati, 1888) 2: 289–290.

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Daniel Drake: The New Western Naturalist

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Daniel Drake was born in 1785 near Bound Brook, New Jersey, but grew up in the Ohio Valley at Limestone (now Maysville), Kentucky, to which the Drakes moved in 1788. In his youth he was a close student of nature, he later remembered, but he had a more conventional education as well, after which—at the age of fifteen—he began an apprenticeship in medicine and surgery with Dr. William Goforth of Cincinnati, then the most prominent practicing physician in the region.[2]

By the spring of 1804, Drake had satisfied Dr. Goforth as to his competence and his reliability. He knew, we may presume, much of what Goforth knew about the diseases to which mankind was subject, at least their names and their symptoms, and both the conventional and practical ways to treat them; about the materia medica of use to physicians at the turn of that century, and perhaps something also about the Americans' hope that in their western forests would be found botanicals which could substitute for older and unavailable substances, or could supplant the older materia medica entirely; some anatomy and physiology, and the rudiments of surgery and midwifery as it was then practiced; something of the necessity for accurate record-keeping in the

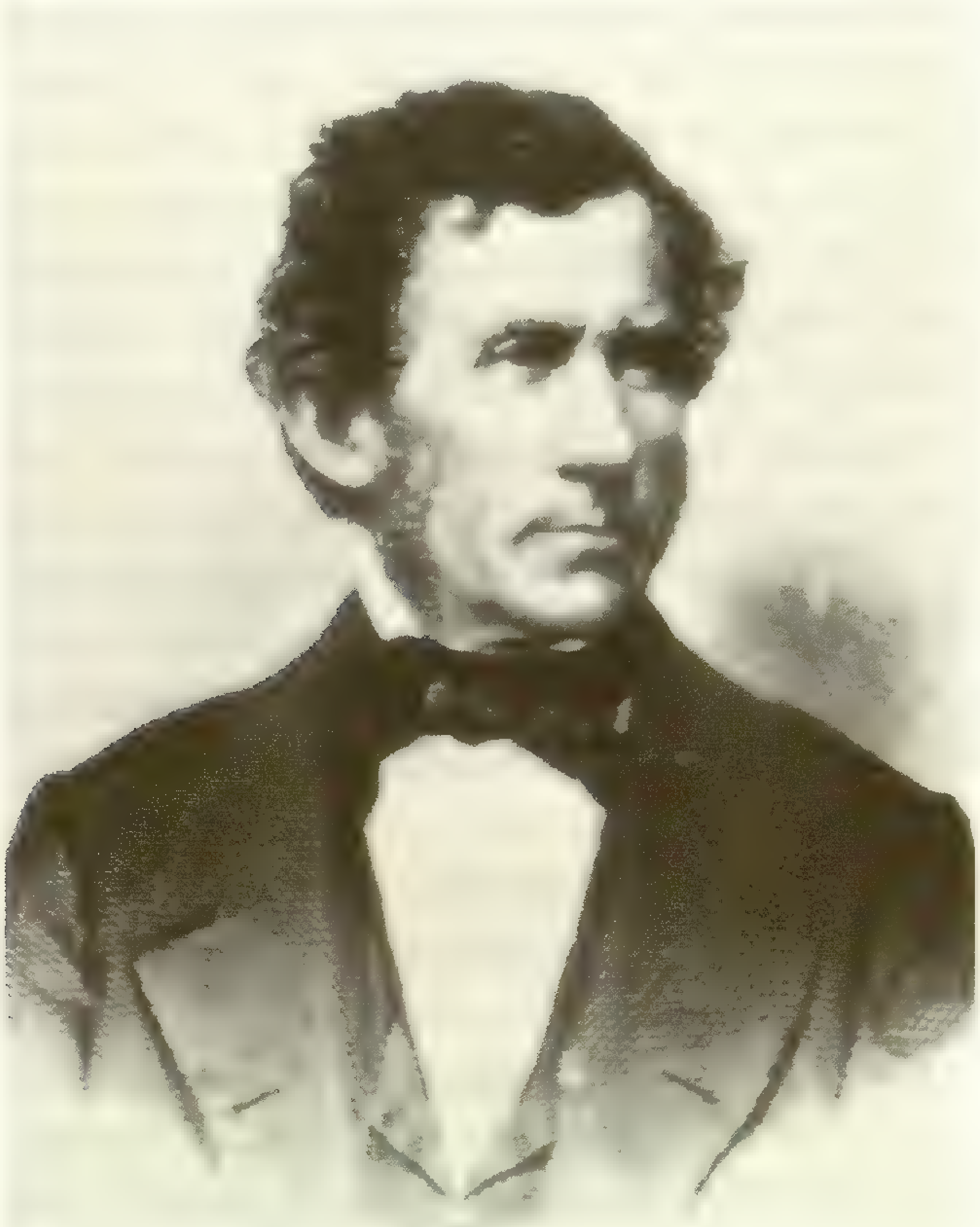

FIG. 1. Daniel Drake (1785–1852). An engraving by C. A. Jewett & Co., Cincinnati. Opposite title-page in Edward D. Mansfield (1855), *Memoirs of the Life and Services of Daniel Drake, M.D. . . . ,* Applegate & Co., Cincinnati. 408 pp.

practice of medicine and accurate bookkeeping in the conduct of a medical practice; and a sense of the proper social role of the physician in modern society—his obligations and his perquisites both. At the end of the apprenticeship Goforth issued Drake a certificate of accomplishment, and took the young man into partnership.[3]

By the autumn of 1805 Drake had become sufficiently cognizant of the limitations of the practical training he had received during his apprenticeship, and of the practical advantages which a more academic education in medicine might bring both to his competence and to his career, that he set out for Philadelphia with the intention of enrolling at the medical college of the University of Pennsylvania. There he attended the lectures of Rush, Woodhouse, Wistar, and Physick—and some at least of the lectures of Benjamin Smith Barton—but he did not stay long enough to complete the requirements for the degree.[4] Financial difficulties cut short his course of study in Philadelphia, and he returned to the Ohio country in the spring of 1806 and set up in practice near his parents' home, in Mays Lick, Kentucky. After a year there, the opportunity to purchase Goforth's practice brought Drake back to Cincinnati and marked the beginning of that extraordinary career as physician, politician, businessman, and promoter of high culture in the west which brought him wealth and prominence locally, and a national reputation as the public face of medicine and science in the interior valley of North America.

In December 1807, Drake married Harriet Sisson, a niece of Jared Mansfield who, as Surveyor General of the Northwest Territory, effectively controlled the distribution of the public lands in the region. Under Mansfield's tutelege, Drake began to invest in downtown real estate (when Mansfield left for Washington to take up the position of Surveyor General of the United States, he put Drake in charge of his own extensive holdings in the area)[5] and through his association with the Sissons and the Mansfields gained instant entree to the social and financial elite of Cincinnati—who turned out also to be the cultural and scientific elite of what was still at that time a village in the back woods. Drake was in any case welcomed warmly into the community, as one who shared their aspirations for Cincinnati. With the completion of *Notices Concerning Cincinnati* in 1810 he emerged as their principal spokesperson and intellectual leader. His examination of the climate, geology, and natural history of the Ohio Valley with special reference to its impact on the civil history and cultural possibilities of the region was clearly shaped by the hopes of Cincinnatians that their city would prove to be the prime location for the development of high culture on the frontier, but its publication itself advanced this possibility. As a book about Cincinnati and published in Cincinnati, it gave the city its first taste of national visibility as a center of literary and scientific culture. It also provided Drake himself with the beginnings of a national reputation, manifested in the extensive (though frequently unfavorable) reviews which his book received in eastern as well as western journals and then in his election to corresponding membership in the Linnaean Society of Philadelphia.[6]

During the next years, Drake set about constructing a system of social, intellectual, and institutional forms which were designed to facilitate the achievement of high culture in the Ohio Valley and thereby the equality of this newly-settled region with older portions of the nation. He was an active member of the Cincinnati Lyceum and of the Cincinnati Library Association. In 1812 he helped organize the First District Medical Society, in 1813 the School of Literature and the Arts which—despite its name and the poetical reading which began each meeting—must be accounted the first scientific society in the Ohio Valley.[7]

In 1813, Drake was elected a trustee of the Cincinnati village corporation and shortly thereafter announced his intention to publish a general work describing the advantages of life in Cincinnati based on a survey of its natural and civil history, and designed to serve both as immigrant's guide and as an additional reminder to the American population that Cincinnati was alive and well in the Ohio Valley. In 1814 he helped organize the Cincinnati Lancasterian Seminary, a private (proprietary) school for the education of young people based on the "each one teach one" system developed by Joseph Lancaster in British India. (There were no "public" schools in Cincinnati at this time, although public funds—derived from the rent of a reserved section in the township as provided by the Northwest Ordinance—were available for the support of education and were distributed to schools on the basis of daily attendance. The Cincinnati Lancasterian Seminary was thus assured of an income to support its activities.)

Some of these activities were surely conditioned by the new national sense of independence which accompanied the outbreak of war in 1812, and which, especially in the trans-Appalachian west, yielded a consciousness of the separateness of the interior valley of the continent from those seaboard areas vulnerable to British invasion. But the mood was national, not merely regional, and these years saw an explosion of activity in the east and south as well as in the west, all designed to establish the institutions of high culture appropriate to a mature nation, including a "native" American literature and an indigenous American historiography, and to investigate the details of American natural and civil history. It was as if Americans were suddenly taking themselves seriously.[8]

In 1815–16, Drake was back in Philadelphia (with Harriet and the children along for company) to complete the work required for his M.D. degree; when it was finally awarded him in May 1816, be became the first westerner to be accredited in medicine by an American university. By that summer he had returned to Cincinnati to resume his medical practice and to supervise the publication of his *Natural and Statistical View, or Picture of Cincinnati and the Miami Country*. In 1817–1818 he held appointment as professor of botany and materia medica on the newly-organized medical faculty at Transylvania Univeristy in Lexington, but on his return to Cincinnati in the spring of 1818 put his plan for the achievement of high literary and scientific culture into full gear. In May he offered a series of subscription lectures in botany, designed for the general public, through the Cincinnati Lancasterian Seminary, and during the summer participated in the organization of a medical faculty in Cincinnati. In 1818–19 medical lectures were offered through the Seminary, while Drake and his colleagues appealed to the Ohio General Assembly for a charter establishing the medical College of Ohio.

In 1819, Drake helped organize the Cincinnati Society for the Promotion of Agriculture, Manufactures, and Domestic Economy which, under a variety of names (including "Cincinnati Society for the Promotion of Useful Knowledge" and "Educational Society of Hamilton County") continued to meet off and on during the next twenty years, and disappeared only after its merger with the Western Academy of Natural Sciences in 1840–41. In 1819 also, he led in the organization of the Cincinnati College to serve as successor to the Lancasterian Seminary and in the establishment of a Western Museum Society to collect and display specimens in natural history, botany, and geology, and data in meterology and epidemiology, thereby providing the "cabinet" necessary to support the scientific work of both the College and the Medical College. In the following year, he obtained a legislative charter for the Commercial

Hospital and Lunatic Asylum of Cincinnati as an essential adjunct to the work of the Medical College of Ohio, providing a "medical cabinet" where living specimens of disease might be studied. His activities yielded numerous honors, including election to corresponding membership in the two most prestigious learned societies in the United States, the American Philosophical Society of Philadelphia and the American Antiquarian Society of Worcester, Massachusetts, and to a seat on the board of directors of the newly established Cincinnati branch of the (Second) Bank of the United States.

During the next decades, his activities in these several areas began to bear fruit in Cincinnati's prosperity and sophistication, apparent both to visitors and permanent residents, and in his own growing reputation. He maintained an active and successful medical practice in Cincinnati and an extensive consulting practice—by mail, following the example of one of his teachers at Philadelphia, Benjamin Rush. He corresponded with the leading naturalists of the day, sometimes in an effort to persuade them to join him in Cincinnati. His medical and scientific articles were welcomed by the editors of the learned journals of the day, and his public lectures were well received by audiences both in Cincinnati and in Lexington where, during the winter months from 1823–27, he held appointment as a member and then dean of the faculty in medicine at Transylvania. In 1827, following the death of his wife, he gave up his professorship and, back in Cincinnati, began a distinguished career as editor of the Western Journal of the Medical and Physical Sciences—known throughout the nation as "Drake's Journal" in the same way that the Philadelphia Medical and Physical Journal had been known as "Barton's" and the American Journal of Science and Arts was known as "Silliman's".[10] During this period also, Drake became an outspoken advocate of the necessity to integrate the "back woods" of the trans-Appalachian west into the life of the nation—a position he maintained even during his long sojourn in Louisville, the Kentucky heart of both southern and western sectionalism, where he held appointment as professor of clinical medicine and pathological anatomy from 1839 to 1849.

Drake's commitment to sectional integration took a variety of forms. One was his personal quest for a national reputation as physician and naturalist. A second was his self-conscious attempt to replicate in Cincinnati and the west those institutional forms already established in the eastern sections of the country as appropriate to American needs and American ("democratic") possibilities. And a third was his continuing search for ways to establish economic and cultural linkages among the geographic regions of the United States, especially in the years after 1820 as sectional self-interest and inter-sectional competition began to threaten the viability of the nation itself.

In all of these, but in the last most particularly, Drake found the pursuit of "science" of particular use.[11] The pursuit of science was important in and of itself as a contribution to mankind's understanding of how the world worked, of course, but for members of Drake's generation it was also an obligation, an essential element in the leadership which the educated elite (whether rich and well-born or not) were to exercise in a republic. Some might pursue the "science" of civil history, other might pursue the "science" of natural history, but each must participate in the advancement of knowledge—and in its transmission through publication, formal teaching, or at the least the "each one teach one" method of the Lancasterian system of education then in vogue —if the United States were to fulfill its mission as the realization of enlightenment hopes and aspirations, as city on a hill and beacon unto the nations. Drake's convictions on this matter may have been learned first at Dr. Goforth's knee—the ideas were certainly "in the air" by the time of his medical apprenticeship—but it is clear that he returned to Cincinnati in 1806 after his first year of study in the medical department of the University of Pennsylvania persuaded not only of the appropriateness of scientific inquiry for physicians and with the outlines of an appropriate program of research learned from the lectures of his great teacher at Philadelphia, Benjamin Smith Barton, but also convinced that science was an American obligation. In later years he was to become one of the nation's principal spokespersons for this idea.

Science, for Drake, was indeed the quintessentially American enterprise. In its pursuit, however, the native ground of his own western region possessed both disadvantages and special opportunities. The disadvantages lay in the absence of trained observers, familiar either with the methods of research or the phenomena to be investigated; in the absence of cabinets of specimens (or data) which might function as types, and thus assist in the classification of the new specimens (or data) which research might uncover; in the absence of learned societies and learned journals through which the data of observation might be shared, and the accuracy of observations checked; and, most profoundly, in an essential uncertainty as to the applicability of "known" knowledge to the particular circumstances of the unknown western region of the United States.

For these same reasons, however, the western region offered opportunities absent in the longer-settled and better-known portions of the country. In the west, about which so little was known and where savants were few and far between, an individual might contribute to the nation's store of knowledge through direct and untutored observation of nature, and might dare to the pursuit of science without deference to an established corps of adepts. In the west, where institutional systems were fluid, collections might be made, catalogues prepared, learned societies and learned journals established on a democratic basis, open in their operation and membership to all who would participate in their activities. Unfettered by the dead hand of the past, moreover, the west offered those who would pursue science an opportunity to confront nature directly, to see its operations without the filtering lens of old theory.

The west thus held out the promise of fulfilling the Baconian ideal: a world available to the human understanding through observation and classification. Through the pursuit of science, moreover, a new western elite might establish its credentials as the equals of that older elite of the eastern states—which Drake himself sought to do, while the learned societies of the west might take their place in a network of societies which, by exchanging information, would push forward mankind's knowledge and aid in the fulfillment of America's mission.[12]

It is in this context that Daniel Drake's role in the history of botany must be understood, for his botanical accomplishments were marginal to the practice of botany itself.[13] His name is linked with no species of his own discovery. By his own account, he engaged in numerous botanizing expeditions in the Ohio Valley—and later in the upper midwest and lower Mississippi Valley—but these were directed less at an effort to classify species or to collect "types" than to catalogue the botanical resources of the region, to use the distribution of readily identifiable trees and plants as clues to the climate and geology of the areas in which they occurred, and thereby to assess the "habitability" of the west as compared to the seaboard sections of the continent. He advocated the establishment of a permanent, public collection of western plants and trees in the form of herbarium, arboretum, or public garden but appears to have created no such collection himself, and there is no evidence that his advice or encouragement influenced those western botanists and horticulturists who did establish collections during Drake's own lifetime, much less that extraordinary group of younger men active during the 1840s, who made the Western Academy of Natural Sciences of Cincinnati a center for botanical research, organized the Cincinnati Horticultural Society, and then acquired land for the establishment of Spring Grove Cemetery as arboretum and botanical garden as well as burying-ground.[14]

Yet his interest in botany, especially during the years following his return to the Ohio Valley after his first period of study in Philadelphia, was both active and serious. His first major publication, the 60-page volume entitled *Notices Concerning Cincinnati* (1810–11), had its origin—according to Drake's own prefatory remarks—in his attempt to prepare a "*calendarium flora* as would exhibit the progress of vegetation at this place, and answer for insertion in [Barton's] Medical and Physical Journal or some other Magazine," that is in his recognition of the importance of botanical inquiry as a contribution to natural science (and as an appropriate, if not perhaps an easy route to scientific publication). He saw the necessity for the preparation of a catalogue of Western plants and trees as an essential part of any assessment of the region's natural resources and as part of a more general inquiry into the distribution of plants and animals, and attempted a preliminary version of such a catalogue in his *Natural and Statistical View, or Picture of Cincinnati* (1816) where it was presented, however, as merely the recorded data of careful observation.

Although the evidence of Drake's publications in this period (as throughout his career) indicate that his principal interests were in climatology and topography, and their impact on the natural and civil history of a region, his familiarity with the literature of botany if not with its practice as a science brought him public recognition and provided him with his first professorial employment. In 1817, as noted above, he was appointed professor of botany and materia medica in the newly established medical department of Transylvania University. In Cincinnati during the late spring of the following year he delivered a course of public lectures on botany to a general audience and then during the winter of 1818–19 lectured on botany and materia medica as part of the first attempt to provide formal medical education in Cincinnati. In 1823, after the collapse of the first Medical College of Ohio, Drake returned to Transylvania, again as professor of botany and materia medica (although he later held the chair in the theory and practice of medicine). During this period, moreover—especially in those prepared set-pieces written as "introductory" or "valedictory" lectures for delivery at Transylvania and Cincinnati in which Drake regularly emphasized the necessity for physicians to obtain a firm grounding in the natural sciences—he seems to have viewed botany as first among the natural sciences. In 1818, for example, he told his students that

> none of the sciences collateral to medicine, are so proper for cultivation by the physicians of the *Backwoods* as Botany . . . for which during the present winter you have I hope had a taste excited. Do not, gentlemen suffer this taste to expire. Follow its suggestions and they will conduct you through fruitful and flowery fields.
>
> You may perhaps be told gentlemen that the study of Botany will interfere with the practice of physic. To this opinion you will I hope turn a deaf ear. Botany, it is true is an extensive science and might constitute the sole study of any man throughout his life. But it would then be a principal: to a physician it should only be an auxilliary study. It is one of the handmaids of practical medicine, and precisely that which is most wanted in a new and unexplored region. Nothing is easier, or more natural for *us* than to connect botanical researches with the practice of our profession and make every distant visit to the sick subservient to the study of this beautiful department of nature.[15]

For Drake, however, botany was never to be merely a private pursuit, the activity of hobbyists and amateurs, or physicians playing at science. The practical value of botany in the development of an appropriate materia medica was clear, but botanical research had a potential usefulness that might extend well beyond the intentions—or indeed the understanding—of the researcher. One could never know the use to which one's own data might be put, Drake knew, and for this reason, especially, he constantly emphasized the necessity for careful observation and accurate description of the processes as well as the products of research, and the appropriateness of using the subjunctive mood in any statement of conclusions. Thus, as throughout his life, while Drake published his own botanical observations as raw data for an understanding of the natural history of the west he *did* publish them, and regularly argued that the publication of data of all kinds was an essential aspect of the pursuit of science. For science was a collaborative activity, which extended across time as well as geographic space, into the past but also into the future. As early as 1812, in his capacity as secretary of the First District Medical Society, he urged his colleagues in the region

> to transmit . . . as early as possible, specimens of the roots, leaves, flowers and seeds of those vegetables indigenous to this state, which he may know to be reputed useful in Medicine or the Arts; together which such information concerning their qualities and virtues as he can collect . . . [and] to make a quarterly report concerning the Diseases of the district in which he practices accompanied with such topographical and meteorological observations as may be necessary to illustrate their causes.[16]

It was to collect such data, and to preserve it against such time as systematic examination might yield true conclusions about its meaning, that medical and scientific societies, museums, libraries, and learned journals existed, Drake knew; and it was to fill the need for such institutions, absent in the newly-settled western portions of the country, that much of his energy was directed. The pursuit of science in the west as in the east required

> a point of concentration—a *Sensorium commune* where all intelligence should be received, compared, digested and again radiated to the profession and society at large to increase the powers of [the one] and the blessings of the other, like the beams of heat and light which emenate from the sun to warm the earth and make it prolific.[17]

Drake's own publications, including his magnum opus, *A Systematic Treatise . . . on the Principal Diseases of the Interior Valley of North America* (1850 & 1852), were explicitly intended to function in this manner, as was the Western Journal under his editorship, where appeared not only medical news and discussions of the etiology and treatment of diseases but also extensive records of data, especially in meteorology and botany, including—as the greater part of two issues—the "Synopsis of the Flora of the Western States" prepared by Drake's Cincinnati neighbor and fellow naturalist, John L. Riddell.[18]

Daniel Drake's interest in botany may then be understood in several ways. He viewed botany as an important adjunct to the study of medicine. He recognized that the study of botany might provide a direct and easily accessible mode of examining the impact of climate and geology on the natural history of a region. He knew also, of course, that botany was itself part of natural history, worthy of study for its own sake and as part of an assessment of the resources and economic potential of a region.

Most important, however, for Drake as for others of his generation, the appeal of botany lay not only in its practice but also in its status, as queen of the natural sciences. Botany, after all, was the science practiced by Linnaeus himself, hence the model for "modern" science in the new age of enlightenment which the 19th century initiated. It required little special equipment, and was therefore available for all who would pursue science, in the "back woods" of the west as in older settled portions of the nation. Its subject matter was familiar and the objects of its inquiry discrete, definable, recognizable phenomena—unlike meteorology, mineralogy, geology, and Drake's own least favorite, chemistry. It required only what all science required, careful observation, systematic collection, and precise classification of the data of nature, but it *did* require these, and in requiring them trained its practitioners in the spirit as well as the method of science.

NOTES

1. Current address: 5 Herrick Mews, Cleveland Heights, OH 44106.
2. The standard modern biography is Emmett Field Horine, Daniel Drake (1785–1852): Pioneer Physician of the Midwest (Philadelphia, 1961), but see also Henry D. Shapiro & Zane L. Miller, eds., Physician to the West: Selected Writings of Daniel Drake on Science and Society (Lexington, 1970). A fuller account, although lacking scholarly apparatus, is Edward D. Mansfield, Memoirs of the Life and Services of Daniel Drake, M.D. (Cincinnati, 1855).
3. Goforth's certificate is on display in the University of Cincinnati History of Health Science Library and Museum, and is reproduced (and the apprenticeship discussed) in Otto Juettner, Daniel Drake and His Followers: Historical and Biographical Sketches, 1785–1909 (Cincinnati, 1909), 24.
4. On Drake's education at Philadelphia, see Physician to the West, xv and notes.
5. The Drake-Mansfield correspondence is in the collections of the Ohio Historical Society.
6. His election to the Linnaean Society is mentioned along with Drake's other qualifications as an authority in natural and civil history in the solicitation for subscribers to his second book, [Daniel Drake,] "Statistical View or Picture of Cincinnati and Its Environs," Liberty Hall (Cincinnati), Sept. 28, 1813.
7. Daniel Drake, Anniversary Address, Delivered to the School of Literature and the Arts at Cincinnati (Cincinnati, 1814) and Physician to the West, 57ff.
8. Cf. in this connection Perry Miller, The Raven and the Whale: The War of Words and Wits in the Era of Poe and Melville (New York, 1956); Henry D. Shapiro, "Putting the Past Under Glass: Preservation and the Idea of History in the Mid-Nineteenth Century," Prospects: An Annual of American Cultural Studies 10: 243–278 (1986).
9. Western Academy of Natural Sciences, Minute Books II, 1840–41, in Cincinnati Historical Society. Also Henry D. Shapiro, "The Western Academy of Natural Sciences and the Structure of Science in the Ohio Valley, 1810–1850," pp. 219–247 in the Pursuit of Science in the Early American Republic, ed. Alexandra Oleson and S. B. Brown (Baltimore, 1976).
10. Drake edited the Western Medical and Physical Journal (Cincinnati) jointly with Dr. Guy W. Wright, 1827–28; the Western Journal of the Medical and Physical Sciences (Cincinnati), 1828–38; and the Western Journal of Medicine and Surgery (Louisville), jointly with Dr. Lunsford P. Yandell, 1839–49.
11. He was also an early advocate of the importance of establishing inter-sectional rail connections as a way of binding the nation together and insuring the maintenance of a national economy, and from the 1830s recognized through his studies of the epidemiology of cholera the real connectedness of all parts of the United States and the manner in which disease transcended state and regional boundaries, but these are separate topics, not discussed here.
12. See especially Anniversary Address (1814), cited supra n. 6; Daniel Drake, Anniversary Discourse on the State and Prospects of the Western Museum Society (Cincinnati, 1820) and Physician to the West, 131ff; Daniel Drake, "Introductory Lecture for the Second Session of the Medical College of Ohio," 1821 (MS. in University of Cincinnati History of Health Sciences Library and Museum), in Physician to the West 168ff.
13. In preparing the final version of this essay I have profited from the opportunity to read the careful review of Drake's botanical work by John W. Frederick, "Daniel Drake and the Botany of the Upper Ohio Valley," Bartonia 54: 83–97.
14. Western Academy Minutes II, especially June 18, 1840, May 3, 1841, April 19, 1842, January 24, 1845, September 3, 1849, March 13 & June 21, 1852. On the organization of Spring Grove as a product of horticultural activity, see Blanche Linden-Ward and David Sloane, "Spring Grove: The Founding of Cincinnati's Rural Cemetery," Queen City Heritage: The Bulletin of the Cincinnati Historical Society 43

no. 1: 17–32 (1985). Drake was certainly aware of this activity, although it occurred largely during his own absence from Cincinnati, and will surely have approved of it, but that is another matter. He attended at least one meeting of the Academy during this period, on October 25, 1842, at which he exhibited plants and minerals collected during a vacation cum naturalizing expedition to the upper Great Lakes during the previous summer, and was an early subscriber to the Spring Grove project, to which he had his wife's gravesite transferred and where he is himself buried.

15. Daniel Drake, "Valedictory to the Class [in Botany and Materia Medica] at Lexington in the Transylvania University" (1818), MS. in University of Cincinnati History of Health Sciences Library and Museum; in Physician to the West, 125ff. Emphasis in original. By the end of his life, however, botany along with mineralogy, had fallen almost to the bottom of the list, after chemistry, natural philosophy (including geology and meteorology), comparative anatomy and the general physiology of organized nature; e.g. Daniel Drake, Introductory Lecture, Thirtieth Session of the Medical College of Ohio (Cincinnati, 1849) and Physician to the West, 315ff.
16. Daniel Drake, "Medical Society, District No. 1," Liberty Hall and Cincinnati Mercury, June 9, 1812.
17. Daniel Drake, "Address to the Lexington Medical Society" (1823), MS. in University of Cincinnati History of Health Sciences Library and Museum. See also my "Daniel Drake's *Sensorium Commune* and the Organization of the Second American Enlightenment," Cincinnati Historical Society Bulletin 27: 43–52 (1969).
18. Western Journal of the Medical and Physical Science (Cincinnati) 8:329–374, 489–556 (1834).

Bartonia No. 54: 48–58, 1988

Rafinesque among the Field Naturalists

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PREPONDERANCE OF EUROPEANS

Any list of naturalists important in the exploration of the Trans-Allegheny region prior to 1825 has to include such names as John James Audubon, Charles Lucien Bonaparte, Charles Alexandre Lesueur, André and François Michaux, and C. S. Rafinesque (all of whom were French, either by birth or culture); John Bradbury and Thomas Nuttall (who were English); Alexander Wilson and William Maclure (Scottish); Gerard Troost (Dutch); and Frederick Pursh (German). Few native-born Americans can be added to the list, Thomas Say being the only major figure who readily comes to mind.

All these field naturalists had acquaintances having kindred interests who were settled on the East Coast. Not all the sedentary naturalists were native-born and several had European antecedents—G. W. Featherstonhaugh (English) and Elias Durand (French) being examples of the former; Henry Muhlenberg and L. D. von Schweinitz of the latter, as their Germanic names imply—but all of them had established positions in society which, by and large, provided them a living. Muhlenberg and Schweinitz were clergymen; Benjamin Smith Barton and John Torrey, though educated as physicians, made their livings as professors, as did L. C. Beck and Amos Eaton; William Darlington, Richard Harlan, and David Hosack were practicing physicians; Durand was a pharmicist; Isaac Lea was a publisher; Stephen Elliott was a banker; Zaccheus Collins was a merchant. Reuben Haines and George Ord inherited money, and Featherstonhaugh married it.[1]

The inevitable rivalry which developed between the field naturalists and the sedentary ones has been accounted for by the plausible explanation that only the settled naturalists, who also controlled many of the publication media, had at their disposal the library resources, museums, herbaria, and other reference collections necessary to classify and order the raw information coming in from the field, especially as new knowledge swelled to riptide later in the century.[2] From this point of view, the best field naturalist was such a botanist as the docile Charles Wright, who flourished around the middle of the century. Wright collected throughout the Southwest, in Cuba, and even in the Far East—then obediently shipped his plants to Asa Gray to publish, satisfied with the small glory of seeing the title *Plantae Wrightianae* (1852–53) on Gray's books. But the earlier field naturalists, and especially Rafinesque, thought otherwise.

For one thing, most of them—Napoleon's nephew being a notable exception—tried to eke out a living by their collecting work. Turning over their collections to others was tantamount to depleting their capital. At a time when the nation could support few academic posts in the natural sciences, and republican sentiment was opposed to public patronage, some of the field naturalists went to extraordinary lengths to sustain themselves while getting on with their work.

Lesueur and Say turned communist in New Harmony. Audubon turned celebrity. Dressed in buckskin he became the toast of London; if he were alive today we would see him touting his bird book on every TV talk show. Nuttall turned bitter, especially after he inherited a small estate in England which required his part-time residence

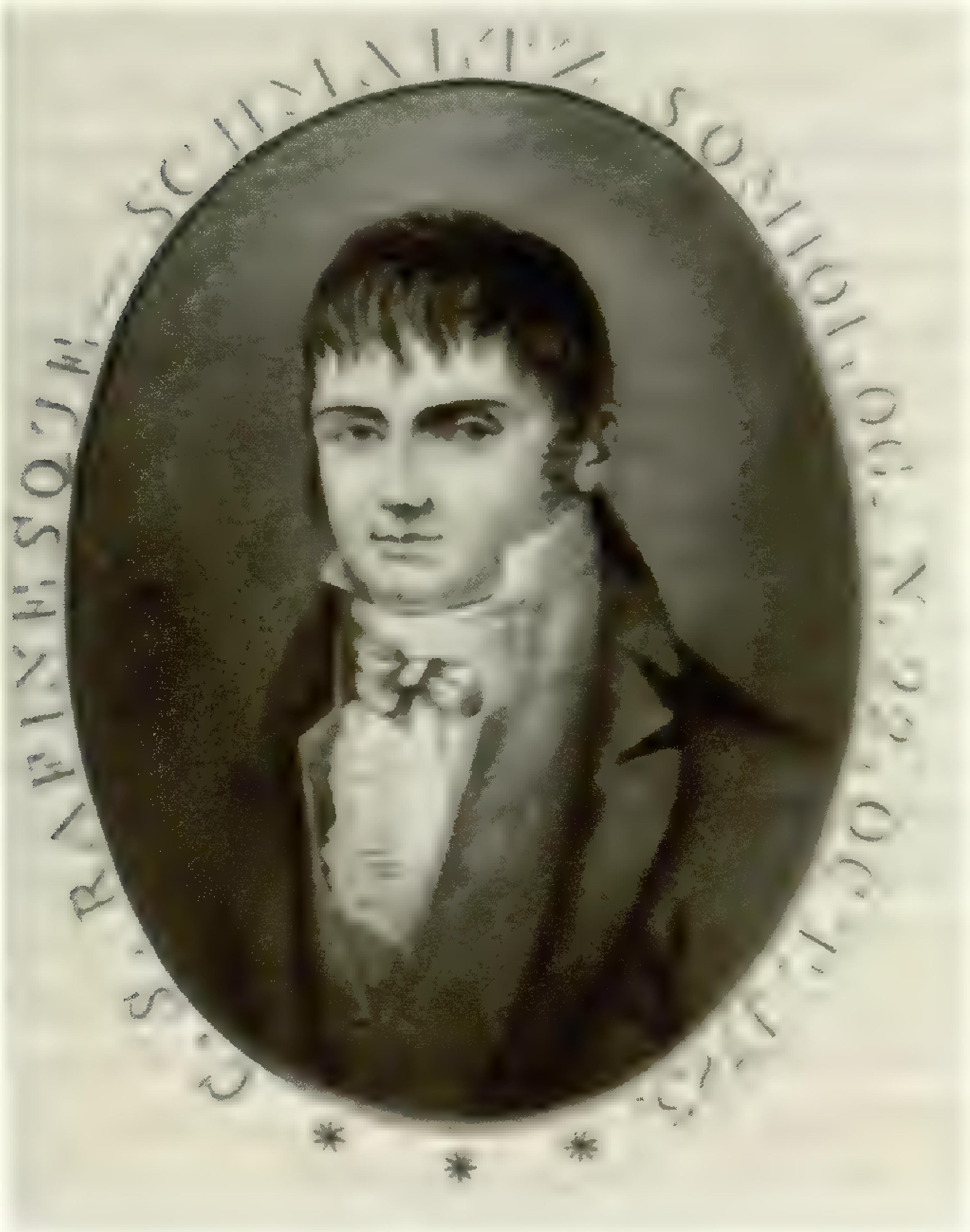
C. S. RAFINESQUE SCHMALTZ SOMIOLOGO N. 22 OC. 1783

FIG. 1. Constantine Samuel Rafinesque (1783–1840), at age 27. Detail of the engraved frontispiece of *Analyse de la Nature* (1815), this and other Rafinesque portraits are discussed, pp. 100–106, in the recently published edition of the naturalist's French-language autobiography (see note 9). Rafinesque hyphenated his mother's Germanic name to that of his father only during his Sicilian residence, to allay suspicion about his French ancestry when it appeared the island might be invaded by Napoleon's armies. In addition to his birth date, Rafinesque has here identified himself as a "somiologist"—the term he invented before "biologist" became common.

there. Wilson died young, and his fiancée buried him. After losing his collections to Pursh, Bradbury gave up natural history in despair and drudged in a cotton mill to feed his wife and eight children. Pursh himself died a drunkard in Canada. And conventional wisdom has it that Rafinesque simply went mad.[3]

He suffered himself to be "laughed at as a mad Botanist," Rafinesque said, in order "to be a pioneer of science." Why he and his fellow field naturalists so gladly chose "the gloom of solitary forests," to "be burnt and steamed by a hot sun at noon, or drenched by rain," while "gnats dance before the eyes" and ticks "stick to you in crowds, filling your skin with pimples and sores" has not been answered, because seldom asked. In retrospect "the pleasures of a botanical exploration fully compensate," he wrote, for the hardships he and the others endured.[4] To give the stay-at-homes a hint of these joys he had to resort to erotic imagery. "Nature is a beautiful and modest woman," he told a lecture audience in Lexington, "concealed under many Veils, some of which she throws aside occasionally or allow[s] them to be removed by those who deserve such a high favor."[5]

Yet one wonders why so many impecunious young Europeans should aspire to disrobe demure Nature in the American backwoods. It can hardly be that, like most of us today, they were educated for the professions they would follow. Of the botanists, only the Michauxes and Pursh had anything resembling formal education in botany. Nuttall, the greatest traveler of them all,[6] was trained to be a printer. Even his biographer was at a loss to explain how Nuttall could anticipate the pleasures of botanical exploration in the New World and go on to alienate his family by rashly undertaking it.[7] Rafinesque came from a merchant family and was intended by his apprenticeship to follow that occupation; all the botany he knew came from his undirected reading.

One clue seems to lie in the foreign birth or background of so many of the field naturalists, and in this respect Rafinesque was typical rather than exceptional. Less likely than the native-born to occupy fixed places in the American social order, they possessed at the same time a greater European sense of the potential rewards of terrestrial exploration. Though Rafinesque's name is especially associated with botany in the history of science, in truth he viewed himself as an explorer first, naturalist second. "A traveler from the cradle," he wrote as a motto for his autobiography, "I'll be one to the grave."[8] It is not much too emphatic to say that he made himself a botanist in order to be a discoverer. In his own language, he was ever a *voyageur;* though the French language lacks the distinction English makes between travel on land or water, the French word does carry a richer connotation of adventure than our paler word *traveler*.[9]

We need to recall that early in the 19th century Europe was still in the expansionist period that began with the discovery of the New World itself. The United States, physically on the margin of Europe's expansion, would not be in a position to participate in global exploration until the Wilkes Expedition of 1835–42, though the impulse to contribute a continental portion was present as early as Jefferson's wish (1793) to send an overland expedition to the Pacific which resulted a decade later in Lewis and Clark's epochal trip. As exemplified by Jefferson's hopes for the Lewis and Clark journey, by the time Americans began to participate in terrestrial exploration the element of scientific research had been added to the process of discovery. Then, as the untouched regions of the globe shrank until only those surrounding the poles remained terra incognita, explorers equipped for the task—as not all of them were—had opened before them vast fields of endeavor in the uncharted flora and fauna of geographical areas otherwise sufficiently well known. This Second Great Age of Discovery, as one historian has called it, may be seen as a scientific revolution.[10] Its lure was reflected in the lives of all the Trans-Allegheny field naturalists. Rafinesque's career, which merited censure during its course and provokes dispute even today, is illustrative of an approach to science long since superseded by a more prosaic and less impetuous manner of discovery.

ADVENTURE AS A MOTIVE

Though most of the details of Rafinesque's early life are unknown to us, his autobiography is explicit about some of his earliest motivations. In addition to the standard subjects taught him by tutors, "I learnt many other things by myself," he wrote, "as I was greedy for reading any book I could get; but I liked travels above all. Those of Leguat, Le Vaillant, Cook, &c., gave me infinite pleasure: I wanted to become a traveler like them and I became such. They increased also my taste for natural history, in which Pluche and Bomare became my guides and manuals."[11]

Left unmentioned in his published autobiographical writings was a French author who had a profound influence on Rafinesque, and very likely—either directly or indirectly—on many other early naturalists as well. This was Rousseau's friend and disciple, Bernardin de Saint-Pierre, whose novel *Paul and Virginia* Rafinesque wept over at the age of 12. The novel's vision of prelapsarian innocence in a state of nature contributed to a romantic ethos that was by no means confined to literature and art. It was a mind-set which caused Rafinesque to exclaim that "every pure Botanist is a good man, a happy man, and a religious man! He lives with God in his wide temple not made by hands."[12] Moreover, *Paul and Virginia* was intended to be part of Bernardin's multi-volume "Studies of Nature," which originally aspired to be nothing less than a complete natural history in the manner of Aristotle. However, its author was wise enough to give up the larger enterprise when he saw that an exhaustive study of the strawberry plant alone would take a lifetime; but of the three volumes of the *Harmonies of Nature* which Bernardin published, Rafinesque wrote that "they would be my library in the solitude" of the wilderness "if ever I was to be deprived of all books."[13]

We know less about the naturalist's father, François G. A. Rafinesque (1750–1793), except that following in his footsteps promised to be the life of adventure his son was seeking.[14] International commerce at that time was fraught with physical as well as financial danger. In 1802, when the Philadelphia merchant John D. Clifford—who later turned out to be Rafinesque's best friend in Kentucky—had shipped as supercargo to Livorno, where he first met the young Rafinesque, he referred to the voyage in his letters as a "merchant adventure." As well he might, for, preparing to return his ship the *Philadelphia* to home port, he wrote to his father and brother about the need to guard against the Barbary pirates. To calm their apprehension, he said he would sail "in company with the armed merchant ship *Serpent* of Baltimore," hoping as a result "there there will be little danger from the Tripolitans"—i.e., in modern context, the Libyans.[15]

It was through the Clifford contact that Rafinesque came, aged 19, to Philadelphia for his apprenticeship. Probably the same connection enabled him, three years later, to work for Abram Gibbs in Palermo,[16] where, he said, he made a small fortune in trade himself, which then enabled him to devote his full attention to natural history. And it was Clifford again, since transplanted to Lexington, Kentucky, where he became a trustee of Transylvania, who wangled for him the only university post he ever held. Had Clifford lived longer, Rafinesque mused, "he might have become for me the Clifort" who was patron of Linnaeus.[17]

Here, it appears, Rafinesque's analogy was faulty. He might better have drawn a parallel between himself and Linnaeus's collector, Pehr Kalm. The truth is, Rafinesque was never comfortable plodding along in the careful, systematic way that brought about Linnaeus's monumental *Genera Plantarum* and *Species Plantarum*.[18] He wanted always to be in the vanguard of exploration, tingling with the thrill of discovery.

After ten years there, Sicily proved too small an arena for Rafinesque's vaulting ambition; he proposed that Sir Joseph Banks send him as a naturalist to Australia. Nothing came of the venture, just as nothing had come of his earlier proposal to join the Lewis and Clark expedition. On his return to the United States in 1815 he was shipwrecked off the coast of Connecticut—losing his savings, collections, and books—and henceforth had to support his travels as best he could, all means of patronage having failed.[19]

It was three years later, in the summer of 1818, that he first made his way across the Alleghenies and down the Ohio as far as Shawneetown—what he called "my great Western tour of 2,000 miles"—and, returning, found John D. Clifford in Lexington, where Clifford pulled strings to enable him to teach there the following year. Without disparaging the hardships of such a trip, we cannot help noting that it was a mere stroll in comparison with Nuttall's several journeys. Yet, in a special way, the trip was indeed a great one for Rafinesque. At the falls of the Ohio, just downstream from Louisville, he had an experience comparable to Darwin's in the Galápagos. In a secular sense, the experience for both men was an epiphany—for it changed their lives—like the turning point in St. Paul's life on the road to Damascus. For Rafinesque, the consequences were immediate; Darwin had to wait another 24 years before he could publish *The Origin of Species* (1859), where his theory of natural selection unraveled such puzzles as those posed by the Galápagos tortoises.[20]

Rafinesque's account of the Western trip is sketchy in his autobiography, *A Life of Travels* (pp. 53–58), but in a remarkable series of letters sent back East while he was on the road he revealed how excited he became with the joy of discovery. The first letter, written from Pittsburgh to Zaccheus Collins on June 1st, concentrated on the botany of the Alleghenies and mentioned the best collecting areas Rafinesque had found crossing the mountains on foot. The second, also to Collins, was datelined "Falls of the Ohio, 20 July 1818," where Rafinesque had stayed for the past 16 days, and it poured out a torrent of discoveries (mostly in conchology and ichthyology). He observed that "fossils are numberless in the valley of the Ohio," but expressed a little disappointment about the prospects for further discoveries in botany, "owing to the peculiar features of the Vegetation of the Western States, which consist in a singular monotony, large tracts of Country being often covered with only a few species." Then, on August 12th, from Audubon's house in Henderson, he wrote again to Collins be-

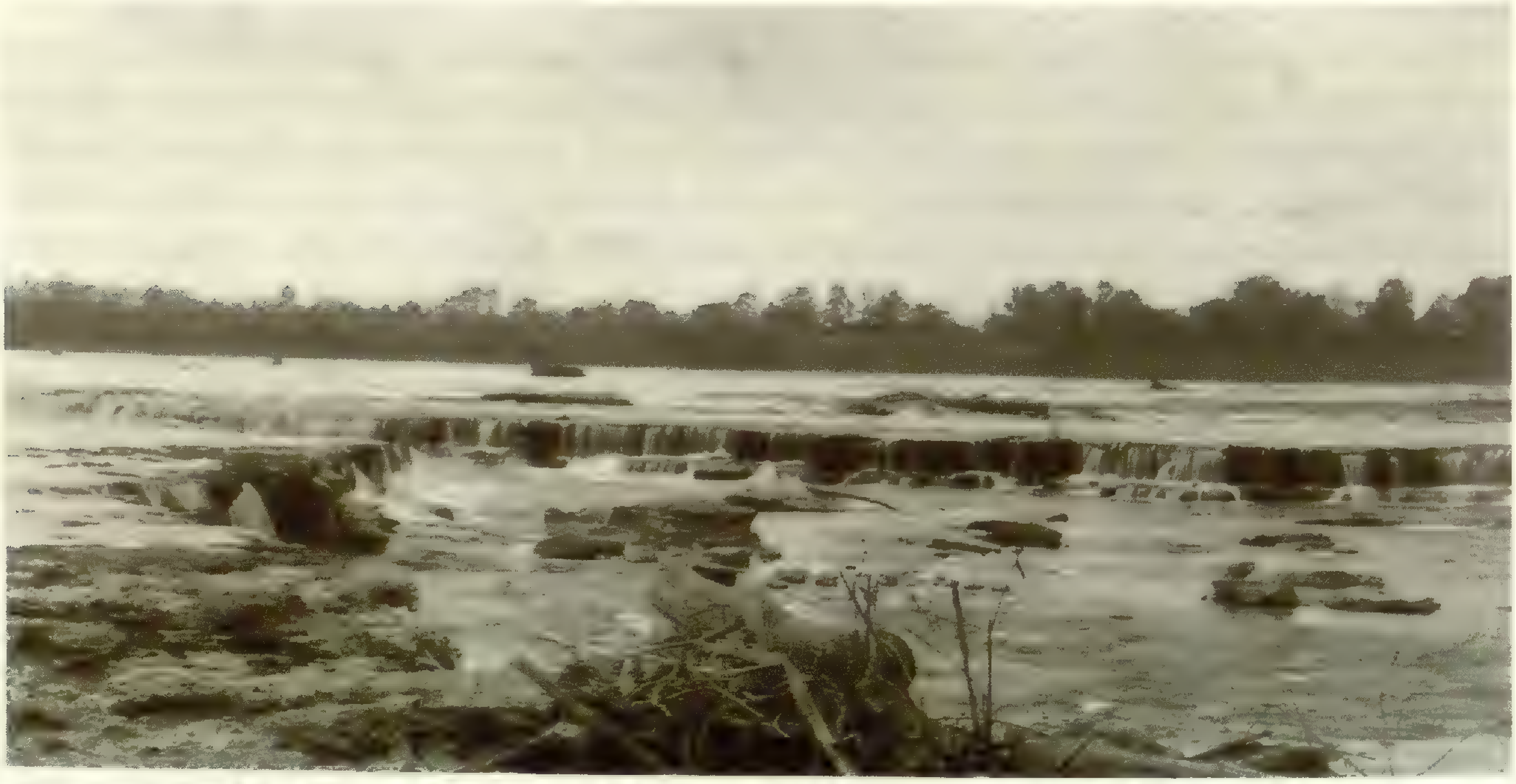

FIG. 2. Falls of the Ohio, a focal point of Rafinesque's field research. Here he named fishes, shells, and fossils while examining plants gathered elsewhere along the river. A fossil madrepore which he dug out of the Ordovician limestone reminded him of the cap worn by Marianne, the symbolic female figure who stands for France. He named it *Turbinolia phrygia* because this "petit espèce ressemblant à un bonnet phrygian renversé." Photograph is courtesy of The Filson Club.

cause "my discoveries increasing daily and so fast, make me anxious to let you know . . . what they consist in," naming new species of bats, rats, reptiles, a few plants, and many fishes—including Audubon's notorious leg-pull, the legendary *Litholepis adamantinus*. But before dispatching the letter he visited the barrens of Western Kentucky and the prairies of Southern Illinois, both of which restored his boundless confidence that new plants would be found abundantly in the West. He attached an equally long postscript to the letter detailing numerous botanical discoveries, a few more shells, a number of fishes, and sent off the whole packet on September 12th, again from the falls of the Ohio, commenting on his discoveries that "they have continued to exceed my most sanguine expectations." Finally, once again from Pittsburgh, he wrote to Collins on November 6th, after his visit to Lexington, mentioning more new shells (both living and fossil)—some of them from Clifford's collection as was a *lusus naturae*, the fossil jellyfish—and more new plants from a fascicle sent to him in Lexington by Charles Wilkins Short from Hopkinsville. He concluded the letter by exclaiming: "The total of New Animals discovered this year by me is 583! of Plants 125!"[21]

Three consequences for Rafinesque's career resulted from his great Western tour which had come to a blinding focus at the falls of the Ohio. The first was his teaching position at Transylvania University, which lasted six stormy years following the death of his protector Clifford. The second was his publication program to make known the Western discoveries, which resulted in such a flood of papers that it was one of the causes—though probably not the most important one—for his contributions being banned by the editor of the *American Journal of Science*, who said that singlehandedly Rafinesque could have filled the whole journal.[22] When other manuscripts were rejected about the same time by the Academy of Natural Sciences of Philadelphia, Rafinesque thereafter turned to French-language journals in Europe, to obscure American media such as newspapers and literary journals, and finally to self-publication in pamphlets and books having almost no circulation—all of which led most of his peers to conclude that they had no obligation to read him at all. And the third consequence—which could have been most important of all, had Rafinesque been more reflective and less impetuous—was the confirmation of his views on biological variation.

Ohio Valley Most Important

The seven years Rafinesque spent in the Trans-Allegheny West provided collections he continued to exploit the rest of his life. When he left Kentucky in the spring of 1826, it took 40 crates to hold the plunder he shipped back to Philadelphia. These years also caused Rafinesque to confront fundamental biological problems, any one of which, had he pursued it as exhaustively as he searched for new species, might have brought him more lasting fame than the exploit of naming 6,700 plants. The issue of biological variation was one of these. Among others which he glimpsed in the course of collecting living plants, animals, and fossils was the importance of plant geography[23] and the significance of index fossils as a means of dating sedimentary geological strata.[24] But Rafinesque never could pause long to think about the meaning of a discovery; he plunged headlong after fresh discoveries—in the field when possible, from other sources when necessary.

Prior to his Western tour, Rafinesque's insatiable desire to discover and name new plants and animals led him to ransack improbable literary sources when the results of field collecting proved disappointing. The first such venture, his publication of *Florula Ludoviciana* (New York, 1817) brought on him opprobrium for having classified plants mentioned by a French traveler which the botanist himself had never seen.[25] During the last decade of his life, he often alluded to the impermanence of species (even genera) as an explanation for his having found life forms undetected by others. Thus, writing of the lopseed plant (*Phryma leptostachya*) found in Kentucky, for which other botanists distinguished but a single species within the genus, he described three distinct species, adding that if others choose to consider them "mere varieties," then at least "they afford a fine illustration of incipient species forming under our eyes in our woods."[26]

Rafinesque's views on the species question have brought him considerable praise, in recent years, as an early evolutionist; but, in truth, as Elmer D. Merrill long ago pointed out, he was largely reflecting the opinions of the 18th century Michel Adanson.[27] Far from having anticipated Darwin, as some have claimed, his views more nearly paralleled those of Charles Darwin's own grandfather, Erasmus Darwin, who also recognized variation. Rafinesque had no way to account for the origin of new species, which Charles Darwin found in natural selection, and Rafinesque's time frame—still the Biblical one—was far too narrow.[28] Yet, the most mature expression of Rafinesque's opinion about species is worth noting, and it is almost totally unknown because it appears—not in any of his technical publications but—as a long footnote to a poem. The book-length poem, *The World or Instability,* is itself in the tradition of Erasmus Darwin's *The Botanic Garden* (1791) and was written as a philosophical meditation on mutability. There Rafinesque declared:

> A species is the collection of all the individuals acquiring distinct forms and colors, and all the deviations that can breed together. They are abstract terms of our own; Nature only acknowledges individuals,[29] and var[ies] them constantly; so as to produce new species now and then, particularly among plants. Genera vary also, but so slowly, as not to be easily perceived. It is probable that new genera are also forming, and that all our generic and specific form[s] of animals and plants have been produced by successive deviations from the original types discovered among the fossils of the former earth.[30]

The most serious thought Rafinesque ever gave to the principles involved in classification must have been prompted by the problems forced on him by the collections he made in the vicinity of the falls of the Ohio. Since he was already known as a notorious "splitter" of botanical genera, the way he was compelled by the evidence to treat certain molluscs found there suggests the degree of judgment of which he was capable but too often failed to exercise.

In the letters to Collins he had mentioned his discovery of dozens of species of a fluviatile bivalve to which he there gave the manuscript generic name *Potamila*. These mussel shells, found in great abundance along the Ohio and especially at the falls, presented "infinite anomalies in form and structure," later causing him to doubt whether all of them could be fitted into the genus *Potamila* after all. He was, in short, presented with the same kind of problem Darwin found in the variation of beaks among the Galápagos finches. Specimens of both creatures exhibited a graduated series without any sharp breaks between species. Rafinesque's first *published* attempt to classify them provisionally accommodated all of these shells under eight sub-genera of the established genus *Unio*,[31] and the genus *Potamila*, though Rafinesque's own invention, was abandoned. After pondering the problem yet another year, what he finally decided was "to give the name *Unio* . . . to all my new species, in conformity with the views of naturalists," for the elaboration even of sub-genera "would render the definition of the species prolix." Despite the fact that the genus *Unio* would "then consist of more than seventy species," he was unable to find justification in the evidence for dividing it.[32] Botanists, who probably give little heed to Rafinesque's zoological writings, would hardly recognize the old "splitter" in this episode. It shows, however, that he was unwilling to denominate new genera in the absence of distinguishing characters evident, at least, to his own eyes.

Yet, his lust for discovery seldom afforded Rafinesque leisure for such extended examination of a problem. It is not generally known that during the last year of his life, when he probably was already suffering from the cancer which caused his death, he read the recently published *Journal of Researches* (1839) of the voyage of the *Beagle*, still exploring vicariously as now he could no longer do on foot. In six pages of cramped notes he made on the book, his halting writing recorded that "Charles Darwin . . . was a naturalist," for, to be sure, this Darwin was unknown in Philadelphia; and Rafinesque went on to note that "seldom Engl[ish] travelers" are "so well informed." He jotted down Darwin's references to many of his own varied interests—ballooning spiders, a new octopus, lizards, frogs, fossils, and tortoises—and he exclaimed with delight that in the Galápagos Darwin had found "26 land birds all new!"

Finally he succumbed to old habits. Reverting to the practice of the *Florula Ludoviciana*, he derived from Darwin's words and woodcut illustration the description of a fungus he himself had never seen—"sessile, globular, bright yellow, on beech trees . . . outer skin with small circular pits" etc.—and resoundingly declared it to be a new species of a new genus named *Endelmis edulis* Raf.[33] The passion for discovery pursued him to the grave.

ACKNOWLEDGMENTS

Ronald L. Stuckey and John W. Frederick gave this text thoughtful critical scrutiny.

NOTES

1. Resident naturalists, though less numerous, also lived beyond the mountains. There were, for example, the physicians Daniel Drake, Samuel P. Hildreth, and John Locke. In Ohio, Hildreth contributed descriptive work in zoology from his base in Marietta, as did Locke in botany from Cincinnati. Whether in Cincinnati, Lexington, or Louisville, Drake pursued his topographical studies of the influence of environment on diseases. Most notable among the botanists was Charles Wilkins Short, briefly Rafinesque's colleague at Transylvania during the winter of 1825–26.
2. See especially Charlotte M. Porter, *The Eagle's Nest: Natural History and American Ideas, 1812–1842* (University of Alabama Press, 1986) and John C. Greene, *American Science in the Age of Jefferson* (Iowa State University Press, 1984). They agree that advancing specialization in all the sciences made the broad-gauge field naturalists obsolete.
3. Lewis David von Schweinitz, William Baldwin, Charles Wilkins Short, and Elias Durand all seriously concluded that Rafinesque was deranged (Ronald L. Stuckey, "Opinions of Rafinesque Expressed by His American Botanical Contemporaries," *Bartonia*, No. 52 [1986], 26–41). The consequences of this view to Rafinesque's career and subsequent reputation are treated in Charles Boewe, "The Fall from Grace of That 'Base Wretch' Rafinesque," *The Kentucky Review*, 7 (1987), 39–53.
4. C. S. Rafinesque, *New Flora of North America* (Philadelphia: Printed for the Author, 1836), I, 11–14.
5. C. S. Rafinesque, unpublished MS "Lecture on Knowledge" (7 November 1820); American Philosophical Society.
6. So much so that Nuttall figures in American literature. Having tramped much of the way from Boston to San Diego, he was picked up on the beach there by the crew of the *Alert*, rounded the Horn with them to return to Massachusetts, and appears as "Old Curious" in Richard Henry Dana's classic *Two Years before the Mast* (1840). It also is widely believed that Nuttall was the prototype for "Dr. Battitus" in James Fenimore Cooper's *The Prairie* (1827), a figure just as plausibly modeled on Rafinesque, who was notorious because of the story that he had collected bats by knocking them out of the air with Audubon's favorite fiddle.
7. Jeannette E. Graustein, *Thomas Nuttall* (Harvard University Press, 1967), who asks, "How did an

English youth before he reached his majority become committed in his heart to so unlikely a project'' (p. 12) as Western exploration? ''His writings give no clue,'' she adds.

8. ''Un voyageur dès le berceau, / Je le serais jusqu'au tombeau.'' C. S. Rafinesque, *A Life of Travels* (Philadelphia: Printed for the Author, 1836).
9. Rafinesque's *A Life of Travels* was written first in a shortened form, in 1833 in French, as *Précis ou Abrégé des Voyages, Travaux, et Recherches de C. S. Rafinesque,* ed. by Charles Boewe, Georges Reynaud, and Beverly Seaton (Amsterdam: North-Holland Publishing Co., 1987), and sent for publication in the *Bulletin de la Société de Géographie,* failing which the author hoped it would be published in the *Annales des Voyages.* Thus he saw geographers and explorers as an appropriate audience for the story of his life, not naturalists.
10. William H. Goetzmann, ''Paradigm Lost,'' *The Sciences in the American Context: New Perspectives,* ed. by Nathan Reingold (Washington: Smithsonian Institution Press, 1979), 21–34. Goetzmann's title implies that the natural history research of the Second Great Age of Discovery is a paradigm in the sense explicated by Thomas S. Kuhn, *The Structure of Scientific Revolutions,* 2nd ed. (University of Chicago Press, 1970).
11. Rafinesque, *A Life of Travels,* 8. François Leguat (1637–1735) was a French traveler to India; François Le Vaillant (1753–1824) explored Africa and described African birds; James Cook (1728–1779) was the British navigator who explored the coasts of Australia, discovered the Hawaiian Islands, and died there; and Jan Janszoon Struys (d. 1694)—included in the French but dropped from Rafinesque's English version—traveled through Greece, Muscovy, Tartary, Persia, India, and Africa. Such was the company of adventurers the youthful Rafinesque hoped to join. Nöel Antoine Pluche (1688–1761) was the author of an eight-volume illustrated compendium of natural history; J. C. Valmont de Bomare (1731–1807) published a five-volume *Dictionnaire Raisonné, Universel d'Histoire Naturelle.*
12. Rafinesque, *New Flora of North America,* I, 15.
13. C. S. Rafinesque, unpublished MS ''Ideas on Harmonies of Nature''; American Philosophical Society. Undated, this MS seems to have been written at the time of Bernardin's death; therefore, *ca.* 1814.
14. Representative of a Marseille firm, he was based in Constantinople, where he married Constantine's mother, who was herself the daughter of a transplanted Saxon family. As part owner of the ship *Argonaute,* he set out on a round-the-world voyage in 1791 which took him to Canton. Returning, the ship put into the port of Philadelphia to escape capture by English cruisers, and there the father died, a victim of the 1793 yellow fever epidemic.
15. John D. Clifford to Thomas & John Clifford; Leghorn, 1 March 1802; Clifford Family Papers, Historical Society of Pennsylvania. On a Mediterranean adventure two years earlier, Clifford turned a 30% profit on muslins in Livorno but, unable to sell nankeens at any price, took the *Philadelphia* to Palermo in company of the *Martha,* which, pointed out, carried 16 guns. To explain his commercial problems to partners in Philadelphia he conveyed such international intelligence as: the Prussians had withdrawn from Italy, Genoa was blockaded by the British, and Bonaparte had defeated the Austrians (John D. Clifford to the Clifford Brothers firm; Leghorn, 29 June 1800; Historical Society of Pennsylvania).
16. Gibbs (banker, merchant, and U.S. Consul at Palermo during Rafinesque's Sicilian residence) is an obscure figure; but Clifford letters mention him as a merchant in Naples as early as 1802. He blew his brains out in 1816, leaving a note that those he trusted were unworthy of the trust. Happily, C. S. Rafinesque had returned to the United States the previous year.
17. Rafinesque, *A Life of Travels,* 114. Clifford's adventures did not end when he turned his attention toward Kentucky. In 1803 he was mugged by a gang of renegade whites while he was passing through the Choctaw Nation in Alabama. In 1804 he loaded 50 tons of cotton on the brigantine *Louisiana* and sailed her from the mouth of the Cumberland River to Liverpool. He died suddenly in 1820. He deserves a biography, but one has never been written.
18. Which is not to say that Rafinesque never tried. His early book, *Analyse de la Nature* (Palermo: Aux dépens de l'Auteur, 1815), whose motto was ''La Nature est mon guide, et Linnéus mon maître,'' was intended to be the Rafinesquian equivalent of Linnaeus's *Systema Naturae;* his *Principes Fondamentaux de Somiologie* (Palermo: Aux dépens de l'Auteur, 1814) of Linnaeus's *Philosophia Botanica;* and his *Good Book and Amenities of Nature,* a periodical launched in the last year of his life which saw but a single issue, was intended to recall the Linnean title *Amoenitates Academicae.*
19. The proposal to Banks is mentioned in *A Life of Travels,* 41. Rafinesque met Jefferson in Washington and wrote to him 27 November 1804, stating his intention to visit Ohio and Kentucky the following spring (which did not occur), adding, ''I wish I could go still farther and across the Mississip[p]i into the unexplored region of Louisiana.'' The offer of employment in Sicily arrived suddenly, for Rafinesque

was gone before Jefferson's reply, written two weeks later, reached him. Some have thought an opportunity to join the Lewis and Clark expedition represented the missed chance of a lifetime; but Jefferson's reply was so diplomatically phrased it is hard to tell whether Rafinesque would have been included or not. See Edwin M. Betts, "The Correspondence between Constantine Samuel Rafinesque and Thomas Jefferson," *Proceedings of the American Philosophical Society*, 87 (1944), 368–380.

20. To be sure, Gertrude Himmelfarb shows in *Darwin and the Darwinian Revolution* (Garden City: Doubleday Anchor, 1959) that Charles Darwin failed to appreciate the significance of the biological puzzles he had turned up in the Galápagos until he reached home and had the help of specialists to sort out his collections.
21. Unpublished, these letters exist in manuscript at the American Philosophical Society. Collins's docket on the back indicates that most of them were read to the Academy of Natural Sciences of Philadelphia. At the same time, Rafinesque must also have copied out the substance of them and sent it to New York, where his discoveries were summarized in a series of articles in the *American Monthly Magazine and Critical Review*, which had been faithfully reporting the activities of that city's Lyceum of Natural History, of which Rafinesque was a founding member.
22. According to its editor, Benjamin Silliman (in a footnote appended to Asa Gray's obituary notice of Rafinesque [*American Journal of Science*, 40 (1841), 221–241]), who said that when he "became alarmed by a flood of communications, announcing new discoveries by C. S. Rafinesque" in 1819 he "returned him a large bundle of memoirs." Nevertheless, as late as 1821 Silliman published the notorious fossil jellyfish, *Trianisites cliffordi*, which two years earlier had been rejected at the Academy of Natural Sciences of Philadelphia, by a committee consisting of C. A. Lesueur, Thomas Say, and George Ord (MS Minute Book, ANSP, 26 January 1819). Whatever the petrifaction may have been, fossil *Medusae* have, in fact, been discovered since in the Flinders Range in Australia.
23. One example is Cosmonist VIII, "On the Botany of the Western Limestone Region," *Kentucky Gazette*, 4 April 1822, where Rafinesque also touched on the idea of plant succession.
24. With Clifford, Rafinesque undertook to produce "a general Descriptive History of all the fossil remains of Kentucky"—an effort that ended with Clifford's death (C. S. Rafinesque to Samuel Burnside; Lexington, 2 October 1820; American Antiquarian Society). The need for this was expressed in his review of *Observations on the Geology of the United States*, by William Maclure, where Rafinesque wrote that "we must especially collect and describe all the organic remains of our soil, if we ever want to speculate with the smallest degree of probability, on the formation, respective age, and history of our strata" (*American Monthly Magazine and Critical Review*, 3 [May 1818], 41–44).
25. Dr. William Baldwin called the *Florula* "a shocking production, to come from one who has placed himself at the head of the botanical profession in our country" (*Reliquiae Baldwinianae*, ed. by William Darlington [Philadelphia, 1843], 282).
26. Rafinesque, *New Flora of North America*, II [1837], 37–38.
27. Elmer D. Merrill, *Index Rafinesquianus* (Jamaica Plain: Arnold Arboretum, 1949), 47–48. Adanson, *Familles des Plantes* (Paris, 1763).
28. Rafinesque sought, unsuccessfully, to honor Erasmus Darwin (not Charles) with a plant genus. After the *Origin of Species* occasioned a furor, Charles Darwin searched earlier literature for quotations to support his own views and printed them in "An Historical Sketch of the Progress of Opinion on the Origin of Species" prefixed to his sixth edition (1880). There he quoted from Rafinesque's *New Flora of North America* (I, 6) that "all species might have been varieties once, and many varieties are gradually becoming species"; this citation has given rise to the belief that Rafinesque "anticipated Darwin." But if mutability were the only issue in Darwinism, then a line of precursors stretched back as far as Aristotle, as Darwin himself well knew.
29. He began to distrust the reality of biological units as early as 1814: "La Nature n'a peut être créé que des Individus ou tout au plus des Espèces, toutes les autres Dénominations ne sont que des notions idéals inventées par nôtre imagination, pour nous faciliter la connaissance des objets"—possibly Nature creates only Individuals or at the most Species, all the other Designations being only ideal notions invented by our imagination, to facilitate our knowledge of objects (*Principes Fondamentaux de Somiologie*, 13).
30. C. S. Rafinesque, *The World or Instability* (Philadelphia: J. Dobson, 1836), 229. The source commonly cited for Rafinesque's evolutionary doctrine is his letter to John Torrey printed in *Herbarium Rafinesquianum* (Philadelphia, 1836), 11–12, where he wrote that "I shall soon come out with my avowed principles about G[enera] and Sp[ecies]"; namely, that "Species and perhaps Genera also, are forming in organized beings by gradual deviations." He concluded with the hope that "If I cannot perform this give me credit for it." Rafinesque did not publish, nor did Torrey give him credit.

31. C. S. Rafinesque, "Prodrome de 70 Nouveaux Genres d'Animaux Découverts dans l'Intérieur des États-Unis d'Amérique, durant l'Année 1818," *Journal de Physique, de Chimie, et d'Histoire Naturelle,* 88 (1819), 417–429.
32. C. S. Rafinesque, *A Monograph of the Fluviatile Bivalve Shells of the River Ohio* (Philadelphia: J. Dobson, 1832), 10–11, trans. by C. A. Poulson from the *Annales Générales des Sciences Physiques,* 5 (1820), 287–322. Moreover, eleven years later he added two additional species to the genus *Unio,* from specimens brought to Philadelphia from the Ganges River in India (*Continuation of a Monograph of the Bivalve Shells* [Philadelphia, 1831], 7).
33. These notes probably are unknown because they appear beneath a most improbable title. They are in a MS notebook: "Book 43d or Z.Y.; Materials for the History of the American Nations . . . By C. S. Rafinesque, 1839"; American Philosophical Society. Later editions of Darwin's book note that the fungus was described by J. M. Berkeley and named *Cyttaria darwinii.*

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William S. Sullivant and His Central Ohio Botanical Associates

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In frontier North America in the eighteenth century, the region west of the Allegheny Mountains was traversed by a few itinerant naturalists. By the beginning of the nineteenth century, the first resident naturalists and botanists had become settled in the region and had begun to identify and catalog the flora of their local areas. Foremost among these in central Ohio was WILLIAM STARLING SULLIVANT (1803–1873), Fig. 1A, who resided immediately west of Franklinton and later in Columbus. During the latter part of the nineteenth century, he gained international recognition for his contributions to North American bryology, the study of mosses and liverworts. These contributions were in the form of exchanges of plant specimens, preparation of sets of *exsiccatae*, publication of scientific papers and books, and development of an extensive correspondence with botanists throughout the world. The definitive biography of Sullivant, prepared by his great-grandson Andrew Denny Rodgers III (1940), weaves together a detailed account of Sullivant's life, botanical research and contributions, and of the founding and growth of Columbus and the surrounding area. Rodgers (1962b, 1969) added biographical information in two later publications, and Stuckey

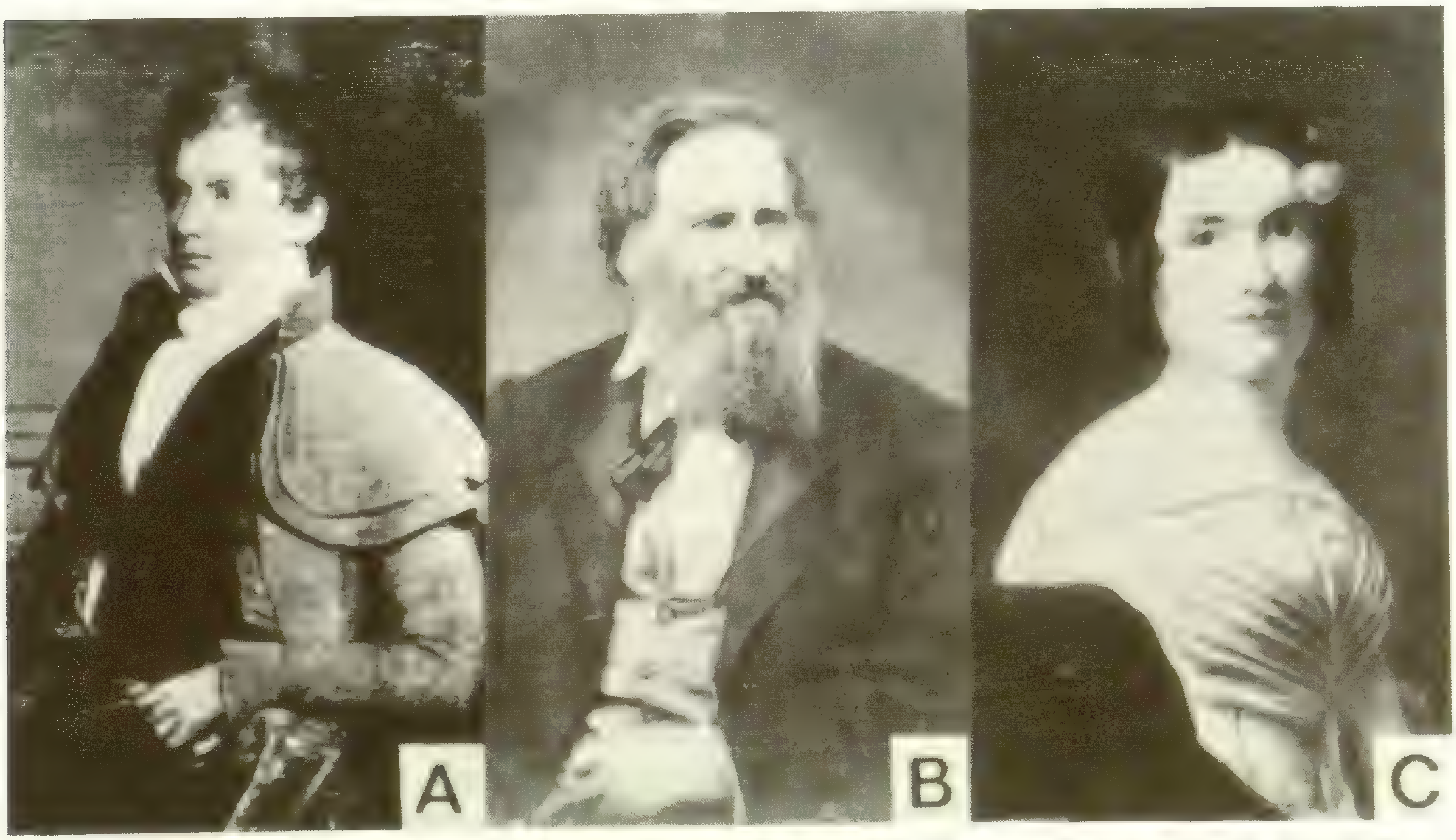

FIG. 1. 1A. William Starling Sullivant (1803–1873) at age 19 or 20. The portrait was painted while Sullivant was a student at Yale College. Reproduced from Rodgers (1940), opp. title-page. 1B. Joseph S. Sullivant (1809–1882). Reproduced from a photograph in the Photo Archives, The Ohio State University, Columbus. Another copy is in the Museum of Zoology, The Ohio State University. 1C. Wedding portrait of Eliza Griscom Wheeler Sullivant (1817–1850) at age 17. Reproduced from Rodgers (1936), p. 97. Also appearing in Rodgers (1940), opp. p. 98.

(1987) compiled a family and botanical history comprised of excerpts from numerous sources.

EARLY DEVELOPMENT AND FAMILY ASSOCIATES

William Starling Sullivant, born 1803 in the village of Franklinton, now part of Columbus, as a lad accompanied his father, Lucas Sullivant, on some short surveying expeditions. At that time he was initiated into surveying, woodcraft, and nature study. Subsequent formal studies were pursued at a private academy in Kentucky, at Transylvania University, at Ohio University, and at Yale College, from the last of which he graduated in 1823, at age 20. William planned post-graduate study, but upon the death of his father in 1823, he returned to his homestead as a wealthy landowner and businessman. On 8 April 1824, he married 16-year-old Jane Marshall, but she died the next January following the birth of their child. Alone during the decade to follow, William gave his attention to the business of managing his large land holdings, mills, stone quarries, banking interests, investments in stage coach, canal, and other companies, while also pursuing interests in civil engineering and surveying.

Rodgers (1940, pp. 100–101, 105) believed that Sullivant's interest in the natural sciences and his focus on botany developed under the strong influences of his youngest brother, Joseph, and of his second wife, Eliza Griscom Wheeler, to whom he was married in 1834. However, Rodgers was unaware of the story told by Dr. Asa Horr, medical botanist of Baltimore, Ohio, in Fairfield County, and companion of William Sullivant. As quoted from Crosby (1915), Horr revealed:

> One day as Mr. Sullivant and I were alone in a boat on a lily pond, gathering lilies and searching for other water plants, he related to me the incidents that led him to the study of botany. He said: "When a young man, by inheritance, I became the owner of the farm on which my present home is situated. I had no plan of life and was rather inclined to be gay and associate with young men fond of a good time. One day I had four of them at my home for dinner and a little jollification. Looking out of a window that showed the pasture in the landscape, I saw a man walking slowly along, closely watching the ground, occasionally stooping down as if to pick up something, stopping to examine it and then putting it in a tin case which was suspended by a shoulder strap at his side."
>
> "I wondered what the man found of so much interest in the pasture, and said to my company: 'Boys, excuse me for a little while! I see a man down in my pasture and I must go down and see what he's doing there!' So I left them and went to the pasture. I found a man somewhat advanced in years who explained that he was studying the flora of the state, and had already found in my pasture some new plants not yet described, that he would add to the list. I staid with him till near dinner time, asked him to take dinner with me and he consented. I wanted to see more of him, and if he were not accustomed to our style of living, it might be some fun for the boys as his clothing was suited to his work. When seated at the table, his dignified bearing and intelligent conversation kept my other guests as attentive listeners, with no thought of making fun at his expense. I asked his permission to accompany him the rest of the day, and adjourned the frolic with my gay young friends. That afternoon opened a new world to me and led me to become a student of nature."

Although the name of the man in the pasture and the date are unknown, it would appear from the story itself that the event occurred before Sullivant's second marriage. His enthusiasm for the study of the sciences did not otherwise become evident until about the time of this marriage. His youngest brother, Joseph S. Sullivant (1874), who had already made some progress in the sciences, also claimed credit for helping to arouse William's early enthusiasm.

The brothers found the richest fields for plant study in the immediate vicinity of William's white brick mansion at "Sullivant Hill," about three miles west of the Scioto River and just beyond Franklinton. William's early botanical efforts were studies of the local flora in which he identified the flowering plants and made an herbarium of them.

Among the plants of most interest were the grasses and sedges. Because of their tiny, inconspicuous flowers, they were a great challenge for him to identify.

To develop his botanical resources further, Sullivant wrote in November 1838 to the North American botanical leaders, Drs. Asa Gray and John Torrey of New York City. From them he sought authentically identified specimens of grasses and sedges that he could compare with the specimens he had collected in central Ohio. He asked that Torrey arrange for Gray, while Gray was in Europe, to purchase books on the mosses and liverworts for him, as well as a high quality microscope, in order that he might begin study of these plants.

In 1840, Sullivant published a *Catalogue* of the vascular plants of Franklin County and surrounding areas in central Ohio. His primary objective was that the catalogue expedite exchanges of specimens with other botanists in the country, rather than serve as a definitive account of the local flora. Sullivant wished to increase his herbarium, and in the year following publication of his catalogue, he began an exchange of specimens, particularly grasses and sedges, with Torrey. In these formative years, Torrey and Gray gave Sullivant much encouragement, accurate information, and constructive criticism which was extremely helpful to the neophyte Sullivant in preparing his early botanical publications. Years later, Gray (1857) was to write in a letter to Sir William J. Hooker of England, "A noble fellow is Sullivant and deserves all you say of him and his works. The more you get to know of him the better you will like him."

Several pioneer botanists are known from central Ohio, and Sullivant appears to have interacted with most but not all of them. A few of his botanical friends are mentioned in his correspondence of 1838 and 1839 to Torrey. In a letter of 18 December 1838, Sullivant asked Torrey to include the names of Mary Ann Aldritch and Lynn Starling, Jr., as subscribers to Torrey and Gray's *Flora* (1838–1843). The former individual has not been identified further, but the latter was a nephew of Sullivant's uncle, Lyne Starling, who had come to Columbus from Kentucky (Rodgers 1940, p. 70). Lynn Starling, Jr., is also mentioned in Sullivant's *Catalogue* (1840, pp. 58, 61) as having collected specimens of *Conoclinium coelestinum* and *Zygadenus glaucus* from wet prairies south of Columbus. Other names mentioned in the *Catalogue*, along with his brother Joseph, are a Colonel A. J. McDowell (p. 59), who had introduced *Martynia proboscidea* into the gardens of Columbus, Messrs. John Rowe and Mr. T. Roberts of Fayette County (p. 58), John Samples of Urbana (p. 59; cf. Stuckey 1966), and Thomas G. Lea of Cincinnati (p. 62; cf. Braun 1934).

JOSEPH S. SULLIVANT

JOSEPH S. SULLIVANT (1809–1882), Fig. 1B, who devoted more time to study than to business as he himself stated, directed his life largely to the promotion of the welfare of the people of Columbus and the state of Ohio. He was an organizer of learned societies and educational establishments and a promoter of natural history in central Ohio. A gentleman of leisure and letters, he had keen interests in art, literature, and science, and was an author on historical, political, scientific, agricultural, and educational subjects. His interest in natural history came early in life, through his preparation in the 1830s of collections of shells, fossils, minerals, zoophytes, and plants of Franklin County. A catalogue of these collections was published (J. Sullivant 1838). Through these efforts he had a direct influence on his oldest brother, William. Although Joseph's interest in science was less specialized than his brother's, he was nevertheless an inexhaustible source of encouragement to young and enthusiastic students in any phase of human knowledge provided only that their work was serious and likely to prove worthwhile (Mendenhall 1915).

Joseph S. Sullivant worked diligently to secure a federal land grant college for Franklin County. In 1870, the Agricultural and Mechanical College of Ohio was founded and located on the banks of the Olentangy River north of Columbus. As a charter member and secretary of the board of trustees until 1878, Sullivant formulated the first course of study at the new institution, which that same year became the Ohio State University (Kinnison 1970, pp. 73, 85). He summarized his contributions to society and natural history in an autobiographical account in *A Genealogy and Family Memorial* (1874, pp. 174–184), the sketch later abridged by Thorne (1909).

Eliza Griscom Wheeler Sullivant

As early as the 1840s, ELIZA GRISCOM WHEELER SULLIVANT (1817–1850), Fig 1C, second wife of William Starling Sullivant, was his co-laborer in the writing of descriptions and preparation of illustrations of mosses and liverworts. She thus contributed to his success in becoming the foremost nineteenth century authority in North American bryology (Rodgers 1936, 1940).

The second Mrs. Sullivant, a native of New York City, was 14 years younger than her husband. At the time of their marriage on 29 November 1834, the seventeen-year-old bride was somewhat timid and awed by her surroundings at "Sullivant Hill." However, with her simplicity and personal charm, she soon won the love of the people she met in central Ohio. For the next 16 years, despite her unsteady health, William and Eliza worked and traveled together, in Ohio and in the southern and eastern United States, in their botanical pursuits. They conducted field work, prepared herbarium specimens of both flowering and non-flowering plants, wrote descriptions in Latin, and prepared exquisite line drawings of mosses and liverworts, some of which were new to science. Many such illustrations are believed to have been drawn and made into plates by Mrs. Sullivant. These drawings were published in William's books, but according to the practice of the time, they were not credited to him or her. For example, the illustrations of mosses and liverworts published in Sullivant's *Musci and Hepaticae of the United States,* which appeared in the second edition of Gray's *Manual of Botany* (Sullivant 1856), may have been prepared by Mrs. Sullivant. Some of her drawings were used for many years in the teaching of botany in Heyl's Seminary, Columbus (Rodgers 1936, p. 96).

Within a little more than a decade, Mrs. Sullivant's contributions to her husband's bryological studies were recognized in this country and abroad. In Strasbourg, Germany, Wilhelm P. Schimper, European authority on mosses, commemorated her in his names for two new species of mosses, *Hypnum sullivantiae* and *Plagiothecium sullivantiae,* both discovered by the Sullivants on rocks in dense woods in central and southern Ohio. The latter moss has been treated as a synonym of *Plagiothecium roseanum* Schimp.

Mrs. Sullivant's garden at "Sullivant Hill" was a model to other garden lovers of the community. In 1845 she received from Asa Gray many live plants from the Cambridge Botanic Garden, but the mansion and gardens were vacated when the family moved to Columbus in 1847.

In the summer of 1850, an epidemic of cholera reached central Ohio, and in order to escape this dreaded disease, the Sullivant family went north to Mt. Vernon, Ohio. However, Mrs. Sullivant, at age 33, took ill and died shortly thereafter. She left a grieving husband and five young children. William wrote of the tragedy to Asa Gray in November 1850, but the letter was not mailed until 12 October 1851. It was a genuine tribute to his wife and a description of her proficiency in botany.

> Oct 12 1851
>
> My dear Gray—I send you an unfinished letter written for you near a year since—Something of the kind (tho this is miserably inadequate) was due to the memory of my late most dear and excellent wife, of whom I can never think without the profoundest emotions of affection & respect—
>
> . . .
>
> Columbus Novr 3rd 1850
>
> My dear Gray
>
> I have several times of late attempted to write to you but I had so dreadful an announcement to make, I found myself unequal to the task. The most admirable of women my dear wife is no more.—In August last she and several of our intimate friends were swept off by a sudden visitation of Cholera at Mt. Vernon, a small town in this state to which we had retired for supposed safety. Thus ends sixteen years by far the happiest portion of my life.—To me she was evry thing. What she was as a wife and as a mother I will say nothing; in those relations few equalled her.
>
> But there is an other subject on which it is fitting that to you of whom she always had the highest admiration I should say a few words. I mean her devotion to botanical studies. In these she was my constant companion & coworker for the last fourteen years; and I can say with strictest truth that more than half of whatever I have done in these pursuits is due to her. Such a clear and discriminating judgment, such memory, industry, energy and dispatch as were hers is rarely to be met with.
>
> She acquired of Latin & German & French sufficient to read botanical descriptions with ease. In the mechanical labour of writing she was of vast assistance to me. She wrote with remarkable rapidity and accuracy. Indeed accuracy was one of the striking qualities of her mind. In the most difficult & delicate dissections and Microscopical examinations she was astonishingly successful. Her enthusiasm for our studies really required to be checked. Her knowledge of Musci & Hepaticae was very extensive. No female I am sure ever equalled her, and few of the other sex excelled her.

To preserve Eliza's memory as a wife and botanist, William S. Sullivant ordered from Italy a white marble shaft, surrounded by an exquisitely carved bust of his wife, framed in a flowering wreath of *Sullivantia sullivantii*, the saxifragous plant named by Torrey and Gray. The monument, erected at her gravesite in Green Lawn Cemetery, Columbus, reads:

Eliza G.
wife of
William S. Sullivant
Daughter of
Eliphalet & Mary M.
Wheeler
Born in the City of New York
March 14, 1817
Died in Ohio August 23, 1850

In the *Genealogy and Family Memorial* (1874), her brother-in-law, Joseph Sullivant, described Eliza's accomplishments as a homemaker and botanist:

> She was a lady of much more than common capacity, gifted with a discriminating and well balanced mind, amiable and good tempered; an affectionate wife and tender mother, she managed the affairs of a large household, and, without neglecting any of its cares or duties, still found time to become an expert botanist, and take part in the many frequently extended and delightful botanical rambles, which, after the lapse of many years, cause the writer to look back with vivid and pleasant recollections to the happy times we had at the "Hill" in the days of "Auld Lang Syne" . . . [She was] a lady of rare accomplishment, and, not least, a zealous and acute bryologist, her husband's efficient associate in all his scientific work until her death. . . .

Physician Associates

In the fall of 1832, Dr. JOHN LEONARD RIDDELL (1807–1865) came to Franklin County to teach chemistry and study medicine in the Medical Department of Worthington College. While in the Columbus-Worthington area he wrote a catalogue of Franklin County plants (Riddell 1834). Waller (1946) suggested several explanations for Sullivant's failure to give credit to Riddell's work, but they lack documentation and seem to be unfounded. The simplest explanation is that when Riddell was working in Franklin County, Sullivant was not yet a practicing botanist. Riddell left for Cincinnati in the spring of 1834. It is evident from Sullivant's letter of 12 December 1839 to Dr. John Torrey that he had seen a copy of Riddell's *Synopsis of the Flora of the Western States* (1835), but it is doubtful that Sullivant knew Riddell in the 1830s. In later years, Sullivant was to visit Riddell in Louisiana, where he taught chemistry, and, on occasion, pharmacy, materia medica, therapeutics, and hygiene at the Medical College of Louisiana in New Orleans, and engaged in numerous scientific and political pursuits until his death (Riess 1977; Skinner and Riess 1985).

Prominent among other local individuals in Sullivant's circle of botanical friends by 1840 were four young practicing physicians. Dr. ASA HORR (1817–1896), Fig. 2A, of Baltimore in Fairfield County, is known to have collected water plants with Sullivant. Their association lasted about ten years, until Horr went to Cleveland to attend the Cleveland Medical College, from which he graduated in 1846 (Anonymous 1894). Later that year Horr moved to Galena, Illinois, and a year later to Dubuque, Iowa, where he continued to practice medicine and also became well-known as an astronomer and meteorologist (Atkinson 1878; Wilson and Fiske 1888; Crosby 1915; Waller 1942). In later life, Horr related the story of how he met Sullivant, to whom he was indebted for early direction in the study of botany (Crosby 1915).

> At the age of 19 I was working about 20 miles from Columbus, Ohio, learning the carpenter's trade. One day I rode horseback to Columbus to purchase a text book on botany for beginners, as I had a desire to study plant life. I called at a bookstore and made my purpose known to the proprietor, and he laid upon the counter a number of books.
>
> After an examination of them I was unable to make a selection, and I asked the advice of the merchant, who said he couldn't tell, but pointing to a gentleman seated in the room, said that man could advise me. Turning to the gentleman, he said: "Mr. Sullivant, will you step here? Here is a young man who wishes to purchase a Botany for beginners. Please advise him which to select."
>
> The gentleman came to the counter and asked if I wished it for myself. I answered that I did, and he very soon made a selection. Then he asked if I felt an interest in such matters. If I did he had a collection that he thought would please me, and if I liked he would take me in his buggy, which was standing in front of the store, and show it to me.
>
> I very gladly accepted his kind offer and I found his home and collection of plants large and interesting. The plants in quantity and variety were larger and finer than I ever had seen, and his explanations and descriptions gave me an increased interest in botany. He took me back to the city and I returned to my carpenter work.
>
> About three weeks after that, Mr. Sullivant sent to me a messenger on horseback, with a letter stating that a party of his friends, ladies and gentlemen, at a time named, were going with him camping on a week's outing for pleasure and research, and extending to me an urgent invitation to join their party, and requesting an answer by the returning messenger. I was a great awkward boy, and knew from my former visit to his home that his company would be of a class with which I had not been accustomed to associate. Bashfulness came over me like a blanket. If he had sent his letter by mail, I could easily have answered it by mail, declining the invitation with thanks; but he had sent a messenger specially to bring it and there could be no mistake. The invitation was not merely formal and he surely desired me to join the party, doubtless for my benefit, and I could not do otherwise than send an answer of acceptance.
>
> At the appointed time, at his home, I joined the company of cultured ladies and gentlemen by whom I was

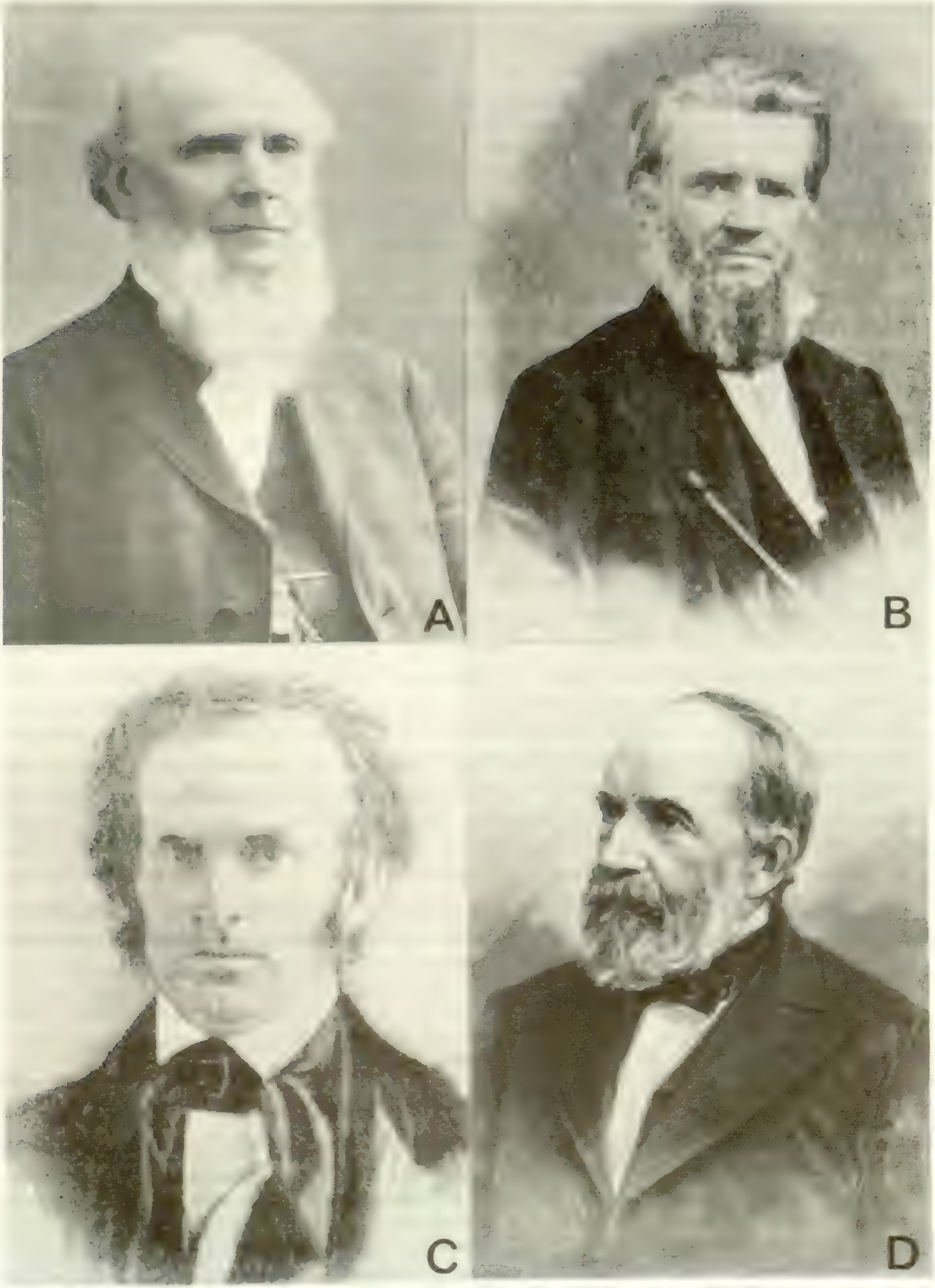

FIG. 2. **2A**. Asa Horr (1817–1896). Reproduced from Crosby (1915), opp. p. 151. **2B**. Jonathan Roberts Paddock (1803–1878). Reproduced from Felter (1902), p. 89; also in Felter (1903), opp. p. 163. **2C**. Ichabod Gibson Jones (1807–1857). Reproduced from Felter (1902), p. 89; also in Felter (1903), opp. p. 168. **2D**. Leo Lesquereux (1806–1889). Reproduced from McCabe (1887), opp. p. 845.

> politely and kindly received. Though it may have been imaginary on my part, I thought I detected a slight air of condescension on their part.
>
> After we had been out a couple of days, a discussion arose respecting some action related in the Iliad. The controversy was growing somewhat heated when, to avoid unpleasant feeling, one of the gentlemen proposed to end the discussion by referring the matter to "our young friend" and letting his decision end the matter; to which they agreed unanimously. It so happened that I had just finished reading a translation of the Iliad the week before, and very much to their surprise I promptly related Homer's account of the matter. The imaginary condescension disappeared and their cordial treatment made me forget that I was ever bashful.

Horr made extensive collections of plants in the neighborhoods of Baltimore and Pickerington, in Fairfield County, and near Worthington, in Franklin County. He was much interested in grasses and sedges and may have worked with Sullivant in collecting and identifying these plants.

Dr. JOHN MILTON BIGELOW (1804–1878), of Lancaster, also collected plants in Fairfield County (Atkinson 1878; Waller 1942, to be read with caution; Stuckey 1978), and worked with Horr to identify their collections of grasses and sedges. Their *Florula Lancastriensis* . . . (1841), published in the *Transactions* of the Medical Convention of Ohio, contained a list of 429 genera and 850 species occurring within the county. A second version was published by Bigelow (1841), and contained notes on medicinal properties. Of this latter publication, editor Thomas W. Colescott (1842) wrote: "Dr. Bigelow urges upon his professional brethren the study of botany . . . [H]e has found within . . . his own county, more than one hundred and ninety species possessing medicinal properties." In the introduction, Bigelow noted that certain plants had been collected exclusively by Dr. Horr, "an intelligent and industrious devotee to Botany" to whom he was "much indebted . . . for valuable assistance, particularly in arranging and determining the extensive orders, Gramineae and Cyperaceae." A few plants that they had not seen in the county were credited to Sullivant, praised by Bigelow as "a most devoted, industrious and intelligent Botanist . . . to whose urbanity and kindness, I am greatly indebted for the determination of many of my plants."

Bigelow did not credit his initial acquaintance with Sullivant to Horr, although that might have been the situation. In letters to Charles W. Short, the well-known physician-botanist of Louisville, and to Drs. Torrey and Gray, he did mention meeting Sullivant. On 21 December 1840 he wrote to Short:

> I have held a desultory smattering with Botany for several years, but from want of company to stimulate to execution—want of books, having had nothing but Eaton and Pursh—want of knowledge, tact, and skill in collecting and preserving plants—and want of time excepting in the earlier part of the season &c. &c. &c. I have been unable to make any sort of tolerable progress in this delightful science.—A little better than a year ago, however, I became acquainted with Messrs. Sullivants, while in my neighborhood herborizing, and by their urbanity kindness and good will, I have availed myself of many opportunities of study, hither to denied me.—In fact the last season is the first in which I have collected throughout the whole of it.—

To Torrey and Gray, on 29 December 1840, Bigelow stated:

> I have smattered a little in Botany for a number of years, but from want of books, company, and proper attention I have neither made any collection of consequence, nor any progress in this delightful Science. Last summer however, I collected pretty thoroughly, having been stimulated to it by an acquaintance with Mr. Wm. S. Sullivant of Columbus. You will observe, that my plants generally, are not put up with that neatness that is required of a professed Botanist; and in some instances they are much injured in the process of drying; this in many instances results from want of time, which is devoted to the practice of a most arduous profession, with which you are in some measure acquainted—Many times, some of my most interesting specimens, are brought home in my hat, and probably before I have time to smooth out some of the wrinkles consequent upon their cramped position in the hat a call is made post haste, and my poor plants are obligated to suffer the withering influences of a hot summer day.—I have become so enthusiastic as to be satisfied with a badly dried specimen, rather than none at all.

Bigelow (1843), who wrote a history of botanical exploration in central Ohio, gave high praise to Sullivant, referring to him as an "ardent, intelligent, and scientific cultivator" of botany. He continued:

> About the year 1837, MR. SULLIVANT and his accomplished LADY, in seating themselves upon their beautiful and highly cultivated farm, two miles west of Columbus, found that they were surrounded with the elements and beauty of *flora's kingdom*. They both determined to enlist under her banner, in determining the extent of Flora's bounty upon their homestead . . . [F]rom becoming the amateur botanists of a few acres, they extended their botanical researches, not only over Ohio, but in a measure, over the whole known world. In the short space of time in which he has been engaged in these pursuits, Mr. Sullivant has, probably, personally collected more plants than any other botanist of Ohio.

Bigelow identified Drs. Horr of Baltimore and Paddock of Worthington, as botanists with whom he was personally acquainted, and who, like himself, were "zealously engaged in exploring the [botanical] riches of their immediate neighborhoods, while arduously engaged in the pursuit of their profession, which precludes . . . the opportunity of making their field of observation as broad as they could otherwise wish."

Bigelow (1849) concluded his botanical work in Ohio with an annotated list of 387 medicinal species of the entire state, the last known publication of this type by an Ohio physician. Bigelow was engaged in two important botanical field explorations in the western United States, namely, the Mexican Boundary Survey of 1850 and the Whipple Expedition for the Pacific Railroad Survey of 1853 (Rodgers 1942; Jepson 1962). In 1860 he settled in Detroit, where he continued to practice medicine and to write on medical botany, and where he died in 1878 (Noyes 1878; Burr 1930; Voss 1978).

Dr. JONATHAN ROBERTS PADDOCK (1803–1878), Fig. 2B, another member of Sullivant's circle, was a classical scholar and physician associated first with the Literary Department and later with the Medical Department of Worthington College, where he taught chemistry, botany, materia medica, and pharmacy. How Paddock and Sullivant became acquainted is not known, but they may have spent many hours botanizing together in central Ohio. They exchanged plant specimens, as evidenced by the presence of some of Sullivant's plants in Paddock's herbarium, which is at the University of Illinois (Anonymous 1920; Stuckey 1978). Their association as botanists was short-lived, however, as Paddock moved to Maysville, Kentucky, following the unexpected closing of the Medical Department of Worthington College in the fall of 1839. In Maysville, he conducted an active private medical practice for the next 20 years, after which he became an invalid and was forced to confine his work to his office until his death in 1878 (Anonymous 1878a, b).

The Rev. J. H. Creighton, physician of Lithopolis and graduate of the Medical Department of Worthington College, stated that Paddock "was an excellent chemist, a splendid botanist, and a friend of Mr. Sullivant, of Columbus . . ." (quoted by Felter 1902, p. 13). In his autobiography, Creighton (1899) wrote that Paddock "was a most excellent scholar." Paddock also has been described as a very skillful physician and classical scholar of extraordinary attainments, "able to name all the plants and trees of the State [of Ohio] by sight" (Felter 1902, p. 90). While in central Ohio, he documented the vascular flora in the vicinity of Worthington, through his active field work and careful preservation of plant specimens. Unlike his central Ohio botanical associates, however, Paddock did not publish a catalogue of the local flora.

Dr. ICHABOD GIBSON JONES (1807–1857), Fig. 2C, another physician in the Medical Department of Worthington College, taught materia medica during the school's early years. He had moved to Columbus in 1834, about the time that Sullivant began his botanical studies. His residence and medical practice in Columbus were interrupted only by a brief tenure (1850–1853) as Professor of Theory and Practice and Dean of the Eclectic Medical Institute of Cincinnati. Jones took an interest in scientific botany and is said to have written "several papers descriptive of indigenous plants and trees, of which the most notable, perhaps, is a description of the grasses of this region; and he prepared an herbarium of the flora of central Ohio, the only complete work of the kind of his time" (Loving 1912). Unfortunately, no such botanical writings have been found, and the last known location of his "complete and beautiful herbarium (still in the possession of his daughter, Miss Emma Jones [d. 9 October 1939, in Columbus])" of indigenous plants was reported by Loving (1904). With his interest in grasses, one wonders if Jones and Sullivant were field companions in the study of these plants. Both men were founding members of the Columbus Horticultural Society and attended meetings together. At the organizational meeting on 12 May 1845, W. S. Sullivant was elected vice-president; Joseph S. Sullivant, recording secretary; and Jones, one of seven managers (Anonymous, 1845). In March 1848, Jones became the second president of the Society (Dodds 1959). Emma Jones (1913) wrote that Sullivant said her father "was the finest man he ever knew."

Paddock, Bigelow, Jones, and Horr constituted Sullivant's circle of young physician-botanists. Paddock, who was the same age as Sullivant, was the senior member at age 36 in 1839, quite possibly the last year that all four physicians and Sullivant were in direct association. Bigelow was a year younger, Jones was four years younger, and Horr was fourteen years younger. It is evident from the excerpts presented here that both Horr and Bigelow received much of their botanical assistance and guidance from Sullivant. Horr reportedly attended the Medical Department of the Worthington College from 1836 until his graduation two years later (Anonymous 1894). However, his name is not included in the lists of graduates of that department (Anonymous 1838; Felter 1902, p. 170). If he attended the school, his early influence in botany may have come from Paddock. Bigelow graduated from the Medical College of Ohio, Cincinnati, in 1832. This school offered no courses in scientific botany, and therefore it would appear that he developed his botanical interests through interaction with Sullivant. Paddock was the only member of this group to hold an early teaching position in a medical school, and thus was in a position to advance botanical knowledge as a part of his profession. He may well have been the most influential member of the group of physicians during their formative years in botany.

Leo Lesquereux

In 1848, Sullivant hired LEO LESQUEREUX (1806–1889), Fig. 2D, a largely self-taught Swiss botanist and geologist who was particularly knowledgeable on the subjects of mosses, peat bogs, glaciation, and coal formation. Born in Fleurier, Switzerland, Lesquereux initially followed his father's craft of watchmaker. After the Revolution of 1848 and the subsequent abolishment of the Society of Natural History of Neuchatel, he followed the example of his friend Louis Agassiz and made his way to Boston, where he served a short term as curator in Asa Gray's herbarium. By the end of that year, however, he was hired as a field and laboratory assistant by Sullivant. Until his death Columbus would be home to the gentle expatriate, and Gray himself would remark much later that Columbus "was known in every country of the civilized world, not on account of its city hall, but because it was the home of William Sullivant and Leo Lesquereux" (Mendenhall 1915).

Lesquereux assisted in the preparation of Sullivant's bryological publications and collections of *exsiccatae*. Following Sullivant's death, he edited the supplement to *Icones Muscorum* (1874) and prepared, with Thomas Potts James, a *Manual of the Mosses of North America* (1884). He is also remembered for his major pioneering contributions to American paleobotany, often made for the numerous pioneering geological surveys of the American middle states and western territories.

Lesquereux's life and work have been treated extensively by Lesley (1895), Rodgers (1940, 1944), and Sarton (1942), but perhaps the most succinct summary of his importance is that of Rodgers (1962a):

> His paleobotanic studies embraced the whole of North America, parts of Europe, and even Australia and Asia. In 1864 he became the first elected member of the National Academy of Sciences, and before his death he was a member of more than twenty scientific societies of Europe and America. Charles Darwin and Asa Gray on different occasions honored Lesquereux, finding in his work important evidence bearing on theories of geographic plant distribution and evolution . . . He was a jeweler and watchmaker by trade, and like Sullivant regarded botany as his avocation. But, as Professor George Sarton of Harvard reiterated. . . , Lesquereux was "perhaps the equal" as a scientist of his close friend Agassiz and "became eventually the leading palaeobotanist of the New World."

And his contemporary, fellow paleobotanist Charles H. Sternberg (1909), added:

> In my estimation, America can show no life more unselfishly devoted to science than that of Lesquereux, probably the most scholarly and conscientious botanist of his day.

THOMAS GIBSON LEA

Who might the plant collector in Sullivant's pasture have been? Since he was described as "somewhat advanced in years," Sullivant's four young physician friends from central Ohio can be eliminated. One possibility is THOMAS GIBSON LEA (1785–1844), a businessman of Cincinnati (Wilson and Fiske 1888; Lea and Lea 1906). In 1834, at age 49, Lea might have appeared as a much older person to the 31-year-old Sullivant. Although Lea is known to have collected plants in the neighborhoods of Dayton, Springfield, and Waynesville in Ohio, and at localities in southern Indiana, it is not known with certainty that he botanized in the vicinity of Columbus. Two known herbarium specimens of Lea's are labeled "Columbus, Ohio" (*Lysimachia lanceolata*, 1837, GH, and *Lythrum alatum, n.d.*, DWC), but the possibility always exists that Lea obtained them from one of his botanical friends in central Ohio, perhaps Sullivant or Paddock. Without some corroboration, it cannot be suggested that Lea ever came to Columbus. How he and Sullivant eventually did meet is also not known, but both individuals were businessmen and certainly would have had common interests other than botany. The suggestion that Lea was the gentleman in the pasture certainly is weak, and perhaps the case should be closed without further speculation as to the identity of this mysterious field plant collector.

Lea had studied in detail the flora of the Cincinnati area for 10 years, and prior to his death in 1844, expressed in writing the desire that Sullivant or John Carey prepare his manuscript for publication (Rodgers 1940, pp. 166–167). Sullivant's last significant contribution to phanerogamic botany was his preparation for publication of Lea's *Catalogue* (1849). Lea's son James later remarked that he was indebted to Sullivant ". . . for the very complete and perfect form . . . " that resulted in the published *Catalogue* (Rodgers 1940, p. 187). Lea's local flora was the first published for the Cincinnati area (revised by Braun 1934).

SUMMARY

William Starling Sullivant's associates in central Ohio may have gained more botanically from him than he did from them, especially Horr and Bigelow, for whom he identified plants. His wife gave him much technical assistance, and his brother must have lent considerable moral support. It is not clear how much botanical interchange he had with Paddock and Jones. Lesquereux was employed by him. Nevertheless, Sullivant became the dominant botanist in central Ohio during the middle years of the nineteenth century. Throughout the trans-Allegheny region, only Dr. Charles Wilkins Short of Kentucky would make similarly significant contributions or command so wide a respect among the botanical community. Eventually, Sullivant brought his considerable talents, energies, educational qualifications, wealth, and professional reputation to bear almost exclusively on the study of mosses and liverworts, and so he became internationally known as the foremost North American bryologist of the nineteenth century. As listed by Wareham (1940), Sullivant named and described 270 species of bryophytes.

An evaluation of Sullivant as a botanist at the height of his work in phanerogamic botany in the 1840s came from Charles Wilkins Short of Louisville. In response to Asa Gray's inquiry as to individuals from the West and South who might supply plants and seeds for the Cambridge Botanic Garden, Short wrote on 26 December 1842:

> The last named individual [Sullivant] is a man of fortune—a *rara avis* among naturalists—and backs his ability by a most ready and obliging willingness to render all aid in the advancement of our common cause. Mr. Sullivant possesses other qualifications as rarely united, I believe, to wealth, as wealth is to the pursuit of Science,—he is indefatigably industrious and labourious; so that I think you may expect more from him than from any other Western Naturalist.

Thomas G. Mendenhall (1915), professor of physics and later a trustee of The Ohio State University, who had visited in Sullivant's home many years previously, characterized him as

> . . . an admirable . . . scientific man . . . , [a] man of genius and scholarly instincts, who, free from the restriction upon his intellectual liberty, pursues with ardent zeal the investigation of some department of science finding his reward in the unalloyed delight of original discovery.

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Edwin Lincoln Moseley: An Internationally Known Naturalist

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Edwin Lincoln Moseley, whose whole life revolved around his teaching profession, was an internationally known naturalist of the first half of the twentieth century. He was recognized in Ripley's "Believe It or Not" for having taught 45 years without missing a single class. Professor Moseley actually taught for 49 years—27 years at the high school level and 22 at the college level. He developed such a good rapport with his students that his classes often extended into Saturday field trips with a dozen or more devoted students eager to help him with his research. He enjoyed the support of the local community, and in turn many of his publications were written to help them. His scientific studies made news in both the local and national newspapers. Moseley gained from in 1939 by making long-range weather forecasts that aided local farmers in drought-stricken areas. In 1948, when news of his death was carried on the Associated Press, editors from both the New York Times and the San Francisco Chronicle called President Frank J. Prout of Bowling Green State University to confirm Moseley's death.

EARLY EDUCATION AND TEACHING

Edwin Lincoln Moseley was born 29 March 1865, just 11 days before the end of the Civil War, hence his middle name Lincoln. He was the youngest of nine children born to William and Sophia (Bingham) Moseley in the small farming community of Union City, Branch County, Michigan, which is about 75 miles west of Ann Arbor. His maternal grandparents, Hiram and Sybil Bingham, were among the first missionaries to work in the Hawaiian Islands (Brown 1940).

Edwin was the youngest member of the first graduation class from Union City High School in 1880. The University of Michigan refused his application for enrollment because he was only 15, so he continued with a year of post-graduate high school. The next year he was accepted. Moseley was very proud of the fact that he earned all but $150 of his college money by picking 25 bushels of wild blackberries in the summer and carving monograms for fraternity boys in the winter. He was the youngest of 82 students to graduate in 1885, and one of two students who was awarded the Master of arts Degree at the end of four years of study (Anonymous 1937).

After graduation Moseley took a high school teaching assignment in Grand Rapids, Michigan, where he remained for two years. His first known publication was compiled there as an unannotated catalogue containing the scientific and common names of the birds, mammals, and bird's eggs contained in the Kent Scientific Institute, Grand Rapids (Moseley 1887).

In 1887 Edwin Moseley joined the Joseph Beal Steere Scientific Expedition formed at The University of Michigan by his former zoology professor. He was one of five men chosen to accompany Professor Steere. For the next two years Moseley was a prodigious collector, while they travelled in the Pacific Ocean to Hawaii, the Philippines,

FIG. 1. Edwin L. Moseley (1865–1948). The original photograph, taken sometime before 1898, is in the Sandusky (Public) Library Company, Sandusky, Ohio. Reproduced from a negative of that picture in the files of Ronald L. Stuckey.

China, and Japan. Twelve months of the 2-year expedition were spent in the Philippine Islands working from two to six weeks on each of the 15 larger islands. Moseley was one of a party of five collectors, working with natives to gather both vertebrates and invertebrates. Many of the specimens they collected had not been described or named, and to honor Moseley, Professor Steere named a beautiful kingfisher *Actenoides moseleyi* (Steere 1890, 1891).

In 1889 Moseley applied for the science teaching position at the high school in Sandusky, Ohio. After a month's deliberation (either over his high salary or whether he would be a good teacher) the school board finally hired him. How embarrassed they would have been years later if they had not hired him! His contract included the following courses for which he was responsible: Algebra, Geometry, Trigonometry, English literature, Chemistry, Geology, Bookkeeping, Botany, Zoology, Latin, Greek, and French. He received $800 per year, well above average in a range that was $300–$900 per year. His final contract with Sandusky High School, before moving to Bowling Green Normal College in 1914, showed an increase to $1,300 with an extra stipend of $200 for his additional responsibility as curator of the museum (Anonymous 1889–1914).

Professor Moseley lived a very frugal existence as a bachelor. He cooked most of his meals in his room or visited friends late in the afternoon, so he would be invited to stay for dinner. He was an unusually healthy individual, despite the fact he weighed only 95 pounds and was 5′10″ in later life.

He had a very limited wardrobe and frequently wore clothes that had been given, rather than buy new ones. His former students said he wore the same blue serge suit for so long that the pants became very shiny. Certainly, he must have thought that what a man did was more important than what he wore on his back. One Sandusky family watched for his change of clothes as an official weather forecaster. The parents would not permit their children to take off their winter red flannels until they saw Professor Moseley change from his warm winter overcoat to his spring light tan top coat.

It is said that he took a young lady to the opera one evening; when the performance was over, he forgot she was with him and went home without her. He certainly would belong to the stereotype of the absent-minded professor.

Museum

In the summer of 1890 Professor Moseley toured European museums with Dr. Charles Graefe, the President of the Sandusky Board of Education to obtain ideas for a natural history museum. When they returned in the fall Professor Moseley met with the Board of Education to explain his project and describe his vast collection of natural history specimens to the members. Not only did the Board of Education grant permission for the development of the museum, but they also ordered four large cases to hold specimens (Moseley 1905). Three months later, January, 1891, he opened the museum in the former superintendent's room at the high school (Anonymous 1890). In a few years he was able to move the museum to a larger room on the third floor. In preparation for an open house, Moseley would have students unpack boxes all day Saturday and set up displays of the nearly 10,000 specimens on the tables in the classrooms. Included were more than 3,000 botanical species, 600 mounted birds, minerals, fossils, mounted mammals, marine invertebrates, reptiles, and marine fish. The exhibitions held about once a month attracted as many as 840 visitors in 1906. Moseley accepted gifts from local donors and traded items with other museums to increase his collection to 17,000 specimens (Anonymous 1924).

Moseley travelled extensively throughout the United States and Europe in search of new material. Natural history specimens collected by Moseley are in the British Museum (Natural History), London; National Museum, Washington D.C.; American Museum, New York; the Field Museum of Natural History, Chicago; and other museums (True 1945). In 1914 crowds visiting the museum dwindled, and by 1932 the demand for additional classrooms forced the Board of Education to store the specimens in the high school attic (Anonymous 1933). In 1938 with eight trucks and a trailer Moseley moved the 17,000 specimens to Bowling Green State University where he placed some of them in display cases in the Science Building (Anonymous 1938). The museum suffered the same fate at Bowling Green, as it did at Sandusky. The demand for classroom space in the 1940's again closed the museum. Today, preserved birds from his museum are housed in show cases in the halls of the Life Science Building, and the plant specimens are in a classroom at Bowling Green State University.

Pre-Glacial River Valleys

Professor Moseley became interested in tracing the submerged valleys of the preglacial streams through Sandusky Bay, Ohio, in 1898 while he was gathering data about submerged timber in the marsh east of Sandusky. A hunter, who had often pushed a boat through the marsh, told Moseley that along a line extending out from the mouth of Plum Brook Creek a setting-pole would go down through the mud 12 feet whereas on either side of the midline it struck the hard bottom at 2–3 feet. Similar stories were told off Johnson's Island in the Bay.

During four winters (1901–1904) Moseley surveyed the Sandusky Bay with the help of about 100 high school boys. They made holes through the ice and probed the hard clay bottom by means of an auger welded to an iron rod, along which would slide an arm provided with a set-screw making it convenient to push, turn or lift the auger at any depth the rod would reach. They discovered each stream had a deep pre-glacial valley through the bay where it joined the larger Sandusky River Valley. The average depth on the sides of the tributaries were about 6 feet while the center was as deep as 20 feet. In several locations the depth of the Sandusky River Valley exceeded 30 feet. Upon the retreat of the glacier the floor of the valley was filled with glacial till. The melting of the glacial ice filled the Bay almost to its present water level. A group of 8–10 boys would work with Professor Moseley all day, so it was necessary to carry lunch, as well as equipment, along with them on the ice. Lunch usually consisted of hot oatmeal. On several trips they took life preservers and pulled a boat, both of which were useful. They returned after dark, several times, to anxious parents waiting on the shore, but no lives were lost (Moseley 1904).

When Professor Moseley completed his survey of the Bay he filed his report with the City of Sandusky, which indicated a natural river valley 30 feet deep and a quarter of a mile wide; however, in 1910 the City Building burned and records were destroyed. In 1918 the Federal Government spent a million dollars ($1,000,000) to blast a channel 24 feet deep and 50 feet wide into the Bay along the Sandusky waterfront businesses to the Lower Lake Coal Docks which opened the Port of Sandusky to deep water shipping. Prior to this time large vessels docked at the Lake Erie side of Cedar Point because they could not navigate into the shallow bay. The new channel enabled Sandusky to increase its commerce with other Great Lake ports (Prout 1959).

By the 1930's the city engineers learned about Moseley's earlier work on the submerged river valleys in Sandusky Bay from a second copy he had filed in the library. A decision was made to develop the deepest river valley into a second channel. The inner channel, which the Federal Government built in 1918, was to be maintained as an entrance channel for incoming ships, because most ships were unloaded and did not "draw" much water. Since 1936 the Corps of Engineers have dredged the silt out of the submerged river valley, which Moseley discovered. It became a natural channel to use for heavily loaded ships exiting out of Sandusky Bay. In 1959 the channel, from the Sandusky Pier Head Light and Fog Horn in Lake Erie to the Coast Guard Station at Cedar Point, was named the Moseley Channel. Naming the channel to honor Moseley was a fine recognition, but the wrong channel was selected. Moseley discovered the exist channel in Sandusky Bay (Anonymous 1959).

MILK SICKNESS

Professor Moseley performed the first successful experiments to prove that trembles in animals result from their eating the woodland plant, white snakeroot, *Eupatorium rugosum,* and that the poison is transmitted through the milk causing milk sickness in humans. Milk sickness, being very prevalent in the Midwest, was a scourge of the pioneer days. Abraham Lincoln's mother, Nancy Hanks, was reported to have died of milk sickness in the community of Pigeon Creek, Kentucky. Nearly one-fourth of the early settlers of Madison County, Ohio, died of milk sickness. In the Sandusky-Erie County area of northern Ohio, prior to 1850, 43 persons died of milk sickness in a single year. Outbreaks of the disease were common in the late summer and early fall before a hard freeze. The early settlers cleared only enough land for their homes, gardens, and pastures. The summer drought would kill the grasses in the pastures, so livestock were grazed in the woods where they ate the white snakeroot plants (Niederhofer 1985).

The dreaded disease, milk sickness, still occurred sporadically in Ohio when Moseley came to Sandusky in 1889. Local farmers related stories of family members being ill or of the loss of sick cattle. A review of the literature indicated a long list of possible causes: foul air, heavy metals, contaminated water, soil conditions, insects, and several plants such as poison ivy, poison sumach, poison oak, cross vine, white snakeroot, yeast, and mushrooms. In 1905, with the help of his students, local veterinarians, and physicians, Moseley undertook an investigation of the disease by collecting bushels of white snakeroot to feed experimental animals kept in the high school laboratory. He taught his students to keep careful records of their observations. His results were presented in a paper before the Ohio Academy of Science as early as December, 1905, which was printed in the Ohio Naturalist in 1906. His most extensive publication came after retirement, in which he summarized the disease's history, various theories of etiology, the symptoms, and his own observations since 1917 (Moseley 1941).

Moseley was recognized for his scientific experimentation on the problem by many noted scientists. Albert Hansen of Purdue University, an authority on weed plants, wrote that Moseley was "one of the first scientists to definitely establish the relationship of a common plant to the disease . . . to him belongs the honor and credit of conducting the first satisfactory experiments to demonstrate that trembles in animals is due to grazing on a common woodland plant known as white snakeroot and that the poison enters the milk, causing human milk sickness (Hansen 1927). Charles C. Deam, botanist and author of the *Flora of Indiana,* commented, "Your contribution on Milk Sickness is an extremely valuable one and if you had never done anything else your life would surely have been worth while." Congratulations also came from Wilbur C. Davidson, Dean of the School of Medicine, Duke University, and E. S. McCartney, editor of the University of Michigan Press (Stuckey 1983 unpublished).

Teaching Philosophy

Certainly one of Professor Moseley's greatest achievements was the teaching of science at the high school and college level to approximately 6,000 students. His objectives were for his students to make careful, critical, original observations of natural events; to seek logical answers to scientific problems, and to be inquisitive enough to ask good questions. The end result would be a student who could think independently (Stuckey 1983 unpublished). To accomplish these goals Professor Moseley involved his students in his research. He was a pioneer in outdoor science teaching. He was quoted as saying, "the cardinal principle to teaching nature is to have the courage and curiosity to take students out and let them study for themselves" (True 1945). Undoubtedly this method of learning was something he had experienced in his early life. He attributed his early scientific curiosity to his third grade teacher who took her pupils on field trips to learn plants they should know.

In my interviews with a few of Professor Moseley's former students I was able to see the impact of his teaching. One former student indicated that because she had developed a "real love of nature" from Professor Moseley's field trips she followed the same philosophy of teaching in her high school classes. Another student related how Moseley had expanded on her natural curiosity. The class had been on an excursion to the Perry and Crystal Caves at Put-in-Bay, Ohio, when she inquired how they had been formed. The next day Professor Moseley brought a geology book and a topographic map to school for her to study. He wanted her to use her natural curiosity to find the answer.

During a classroom discussion of a northeaster storm along Lake Erie, Professor Moseley indicated a similar storm in 1862 had washed away Spit Island directly across from Cedar Point. A student asked, "Why was not Cedar Point also destroyed?" Professor Moseley said he would like to know, too. He organized a student group of about 100 boys, and in the fall and winter of 1902 they drove iron bars down in the eight mile peninsula to the hard blue clay. This was the proof they needed. Cedar Point was formed on a solid blue clay foundation that protected it from the northeaster storms. Spit Island was a sand island, with no rock or clay foundation.

Moseley (1896) discussed four chief causes of failure in high school science teaching: (1) "The pupils study *about* things instead of studying things"; (2) "The schools at the present time appeals to the memory more than understanding"; (3) the use of books is "an exaggerated notion. . . . in all studies"; and (4) there "is an undue regard for logical order in teaching."

WEATHER PREDICTIONS

Moseley retired as Professor Emeritus in 1936 after an impressive 49 years of teaching. Retirement gave him enough time to work on long-range weather forecasts based on his studies of annual tree rings, Great Lakes water level data, information on Ohio River floods, and yearly meteorological rainfall records. He measured the width of annual tree rings from over three hundred stumps of trees cut in various states in the midwest. Wide rings indicated wet years, and narrow rings those that were dry. By knowing when a tree was cut, he could trace the wet/dry periods for the midwest from the Great Lakes and Mississippi Valley. Moseley was able to formulate a theory that the amount of rainfall repeats itself in cycles of 90.4 years or four times the period of magnetic sun spots. Professor Moseley published numerous articles which supported his theory, but his long-range rainfall predictions made in 1939 and read before the Michigan Academy of Science, Arts and Letters attracted the most attention. Newspapers throughout the country carried the noteworthy information. Later that year, a New York Times editorial indicated he was the only scientist to predict the New York state drought in the summer of 1939. While his predictions were not entirely accurate, Moseley did foretell the dry years affecting the low levels of Lake Erie in 1948, 1958, and 1964. He predicted also the wet years of 1952 and 1973—the latter year being, at that time, the record high water level for Lake Erie (Stuckey 1983 unpublished). Moseley's 1939 paper was reprinted by Frohman (1973) to help explain the flooded conditions along Lake Erie.

PUBLICATIONS AND HONORS

During the nearly 60 years Professor Moseley worked actively in Ohio (1889–1948), he was the author of three general science textbooks and 160 articles. Most of the articles were published in professional and educational journals. Dr. Ronald L.

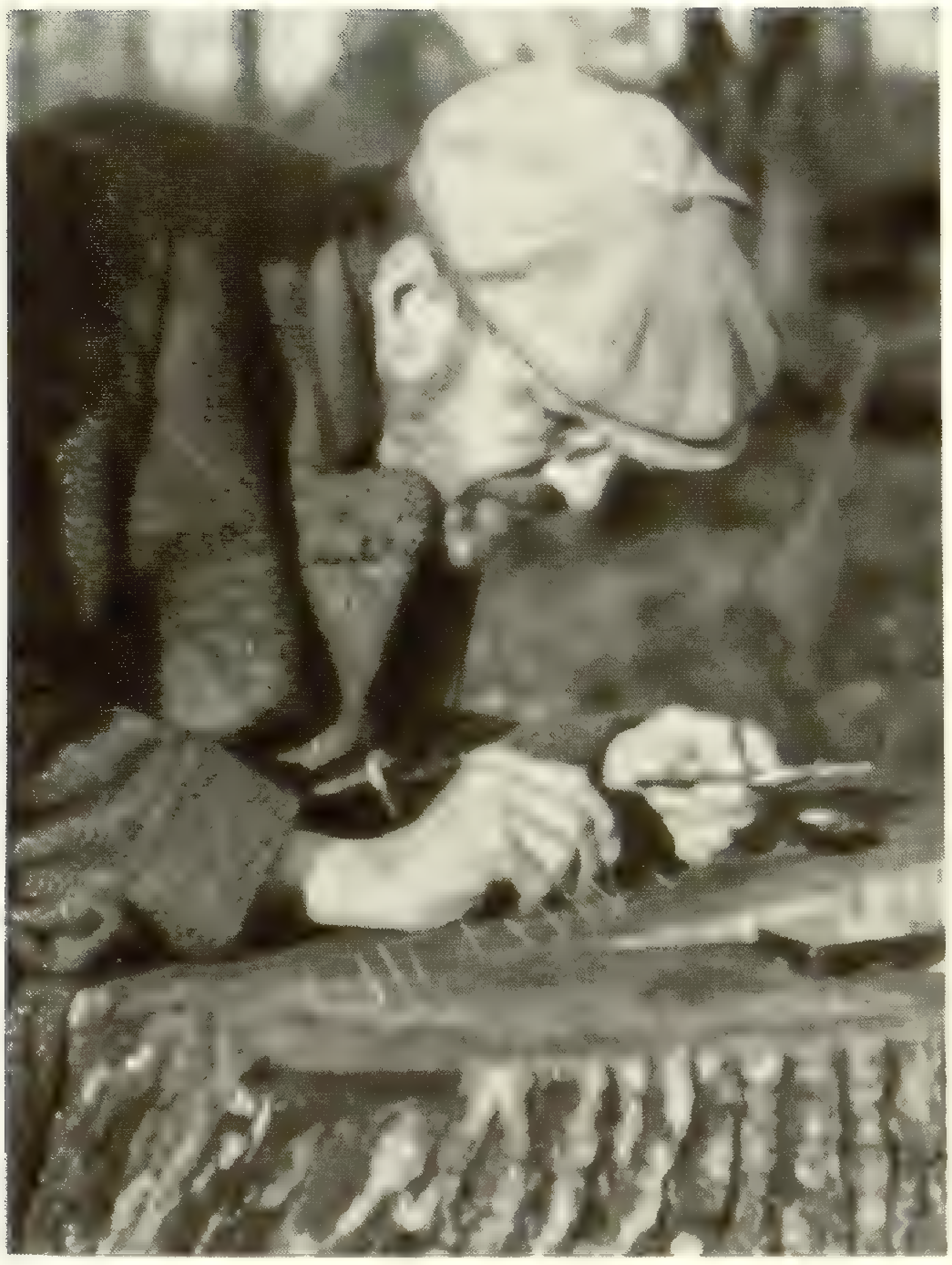

FIG. 2. Edwin L. Moseley (1865–1948). The original photograph, the whereabouts of which is not known, was taken 2 May 1939 by O. E. Ehrhart, Antwerp, Ohio. The bur oak stump, from Allen County, Indiana, is 47″ × 52″, 30″ high, and has 283 annual rings. Reproduced from a photograph published in the Ohio J. Sci. 39: 225, pl. I. 1939.

Stuckey's 1983 analysis of Moseley's publications showed that Moseley published four or more papers each in eight distinct disciplines: zoology, botany, geology, medical science, climatology, astronomy, science education and general science. Moseley's most productive area was zoology with an emphasis on ornithology (Stuckey 1983 unpublished).

In 1943 Moseley was honored as Bowling Green State University's first faculty member to receive the Doctor of Humane Letters. In 1950 the former science building at Bowling Green State University was rededicated and named Moseley Hall. Five species were named for him: a kingfisher bird, a herring-like fish, a coral, a golden rod, and a meadow-rue. Probably his greatest legacy was the nearly 6,000 students whose lives he shaped by teaching them to think and reason for themselves.

SUMMARY

During the first half of the twentieth century, Professor Moseley's reputation developed from that of a local high school teacher to that of an internationally known naturalist. Both his teaching philosophy and his experimental approach to research were well respected. He was a pioneer in outdoor science teaching who involved his students in his research.

Interesting exhibits at his natural history museum, both at Sandusky and later at Bowling Green State University, attracted many local citizens. Professor Moseley educated the entire community.

Professor Moseley's survey of the submerged valleys in Sandusky Bay resulted in an improved harbor to boost Sandusky's commerce. The coal export business especially prospered.

Moseley was the first to prove, by scientific experimentation, that trembles in animals was caused by the ingestion of white snakeroot and subsequently transmitted to humans through the milk.

His weather forecasting attracted the most attention and probably was his most controversial work, but his predictions of abundant rainfall gave hope to local farmers who suffered from crop failures.

Professor Moseley published an impressive number of scholarly books and articles in eight distinct disciplines. His scientific studies resulted in publications with practical applications for local citizens, as well as the scientific community.

After his death, 6 June 1948, he was buried in Oak Grove Cemetery in Bowling Green. The epitaph on his tombstone reads, "Philosopher, Scholar, Scientist, Teacher, and Benefactor." In keeping with his philosophy of teaching, he willed his entire estate of $120,000 to Bowling Green State University to aid worthy students in their education.

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Daniel Drake and the Botany of the Upper Ohio Valley[1]

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No name looms larger in the early history of Cincinnati than that of Daniel Drake (1785–1852), civic-minded physician, scientist, educator, and promoter of high culture. This paper provides chronological accounts of Drake's activities relating to floristic botany and to practical forestry and horticulture. Emphasis is given to identifying his teachers, associates, and students in the natural sciences and to discussing his largely promotional publications on the subject of botany. In conclusion, this paper offers a critical assessment of Drake's place in the larger history of botany in the early trans-Allegheny region.

FLORISTIC BOTANY

Daniel Drake was born in New Jersey in 1785 and came to Mays Lick, Kentucky, with his family of farmers three years later. In 1800, he was apprenticed to Dr. William Goforth (1766–1816) of Cincinnati. Drake probably received his initial impulse to make collections in natural history from Goforth, who, with a Mr. Reeder, made excavations at Big Bone Lick as early as 1802 and whose collections were then stolen and scattered abroad (Cramer 1808; Drake 1816; Cooper 1831; Jillson 1936; Matijasic 1987). In this vein, it may well be of more than passing significance that Drake's earliest known collections were archeological, as reported by Philadelphia ornithologist Alexander Wilson (1810). According to Drake (1816), bones of "no less than six nondescript quadrupeds" and "some of the bones of the rhinoceros" were "examined attentively" in Cincinnati by Goforth and Dr. William Turner of the American Philosophical Society. Drake added that in 1806 Professor Benjamin Smith Barton made an unsuccessful attempt to purchase the collections, and Goforth recounted his memories of the lost bones in a letter to American Philosophical Society President Thomas Jefferson the following year (printed in Cramer 1808; Jillson 1936).

In addition, Goforth's family may have been a source of reinforcement for young Drake's budding botanical interest. Drake (1810) would publish flowering dates for a number of introduced horticultural species, and he may have seen the plants on the property of Goforth's parents, who had settled in Columbia, at the mouth of the Little Miami River, about 1789 (Bond 1923), and who in the Centinel of the Northwest Territory for 24 October 1795 advertised their

> . . . very thriving nursery, consisting of near six thousand trees, composed chiefly of Apple and Peach trees, with a small assortment of other fruit such as Italion mulberries, Almonds, Quinces, Cherries and Plumbs of several sorts. . . .

The papers of Nathaniel Massie, the founder of Chillicothe, contain at least two letters from Judge Goforth, Sr. (1803) in which there is reference to his nursery, and his wife was still selling fruit trees as late as 1808 (Shepherd 1949). Other Cincinnatians known to have cultivated gardens at this early time were Goforth's brother-in-law Colonel John Armstrong, Winthrop Sargent, Martin Baum, Jacob Burnet, the French vintner Menessier, and of course that "delightful old heathen" and father of the American wine industry Nicholas Longworth (Smith 1949).[2]

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[1] An expanded version of a paper read before the Daniel Drake Bicentennial Symposium at the 94th Annual Meeting of the Ohio Academy of Science, University of Cincinnati, 19 April 1985.

A second influence—and one which Drake would never outgrow completely—was Linnaeus.[3] It is not known when or from whom Drake first learned of the Great Swede, but the impression was certainly a most powerful one, as evidenced by Drake's own later testimony (Drake 1870b):

> . . . while I was engaged in the study of Botany, with the *Systema Naturae* of Carolus Linnaeus for my guide, I had become so enamored with the character of the great swedish Naturalist, that I determined to call my first born son after him.

A third influence was the eminent Linnaean scientist, Dr. Benjamin Smith Barton (1766–1815), Professor of Natural History in the Medical Department of the University of Pennsylvania, where Drake first studied in 1805 and 1806. Barton's *Elements of Botany* . . . (1803) was the first such text from an American hand. He also had a very strong interest in "antiquities." In addition to the fact that Drake took Barton's class, his first medical publication appeared in Barton's Philadelphia Medical and Physical Journal in 1808, Drake mentioned Barton repeatedly in the *Notices concerning Cincinnati* (1810), and the two men are reported to have corresponded (Shapiro 1970, p. xv n.). Historians have largely neglected Barton's crucial role in the founding of American botany, but some sense for that role may be had from Pennell (1942), Shapiro (1970), and Greene (1984). This relationship may have given Drake access to Barton's extensive network of scientific correspondents and collectors, among whom Thomas Nuttall was certainly not the least (Barnhart 1925–1926; Mears 1981; Ewan 1988).

But a still more potent influence was at work in Philadelphia, a city still reeling from repeated outbursts of plague dating back to 1793. Notions of "medical topography," i.e., the geography of disease, to which modern conceptions of ecology are the only good approximation, were clearly the most important influence in the development of Drake's medical philosophy (Brodman 1985).

In 1810 and 1811, Drake published his *Notices concerning Cincinnati*, containing a floral calendar, notes on the Columbo root, and the first mention of milksickness. Then, in 1812, Drake first met Dr. Charles Wilkins Short of Kentucky (Horine 1961, p. 329), and their ongoing friendship would be of central importance to the early history of botany in the Ohio Valley.

Drake again studied at the University of Pennsylvania in 1815 and 1816. In Philadelphia, he renewed old acquaintances, made new ones, and learned more about the scientific institutions after which he would fashion similar ones in Cincinnati. These doubtless included the Philadelphia Society for Promoting Agriculture, Peale's Philadelphia Museum, and The Academy of Natural Sciences, of which Drake had been elected a corresponding member in 1812 (Phillips 1967).

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[2] On Armstrong, see also Armstrong (1803) and Haynes (1812); on Baum, see Katzenberger (1935) and Vitz (1958); on Menessier, see Drake (1852); and on Longworth, see Longworth (1849, 1858). The quotation is from Geiser (1932).

[3] For recent descriptions of the trepidation with which native American taxonomic botanists undertook the transition from the classical Linnaean system to a natural method, see Rudolph (1982) and Porter (1986), esp. Chapter 4. Drake seems never to have transcended the older system, except perhaps to the extent that his masterwork, the *Systematic Treatise* . . . , was "strikingly hesitant about the classification of diseases, their etiology, or the most effective mode of treating them" (Shapiro 1985).

A fourth influence, not proved but strongly suspected, might easily have been the affable old Portuguese savant Abbé Jose Francisco Correa da Serra (1750/1–1823), who had corresponded with Linnaeus and who came to this country in 1812, already the intimate of Banks, Jussieu, Humboldt, Cuvier, the DeCandolles, and many others (Davis 1955). Correa had already composed with Leon Perthuis de Laillevault and Jacques Martin Cels a sort of grant proposal entitled "Rapport . . . relatif à la naturalisation des arbres forestiers de l'Amérique Septentrionale . . . ," which appeared as an appendix to F. A. Michaux's *Mémoire* . . . of 1805. During the course of his visit to this country, Correa acted as a sort of travelling consultant to many of the native scientists. Davis (1955) has written: "To him competent botanists from Boston and Charleston appealed as higher authority. Above all be was the medium through which other men on both sides of the Atlantic exchanged plants and ideas." He visited the western country in the summer of 1814, and was entertained by the Short family while in Lexington. He passed through Cincinnati, and although he apparently did not meet Drake at that time, the two men were almost certainly made well aware of one another by medical student Charles W. Short (1814), who shared a rooming house in Philadelphia with Correa and John Vaughan, and whose letters from this period contain many informative references to Correa.

In the spring of 1815, Benjamin Smith Barton left the University of Pennsylvania and went to England in an unsuccessful attempt to recover his health. In Barton's absence, Correa delivered a course of botanical lectures to general approbation. Although Short had left Philadelphia by this time, he was informed of the progress of Correa's lectures by their mutual friend, Edward Barton (1815). For the use of his students, Correa prepared a sixteen-page *Reduction of All the Genera of Plants Contained in the Catalogus Plantarum Americae Septentrionalis, of the Late Dr. Muhlenberg* . . . (1815a, b), a work generally thought to represent the introduction of Jussieu's natural method of plant classification into this country (Davis 1955).

Drake himself stated that he met Correa at one of the Wistar parties in Philadelphia (Mansfield 1855, p. 114), and one may assume that Correa performed for Drake much those same services of criticism and encouragement that he performed for so many other American scientists. However, Correa's scientific activities were drastically curtailed when he was appointed Portuguese Minister to the United States in July of the following year. Still, he was a patron of Thomas Nuttall, who dedicated both his *Genera* (1818a) and his Arkansas journal (1821) to Correa among others (Davis 1955; Graustein 1967, pp. 122, 131, 155). His friendship with Correa would result in Drake's (1825b) last original geological paper, on the formation of the Ohio River.

In 1816, claiming *not* to be a botanist, Drake published his single most substantive botanical work, in his *Natural and Statistical View*. Its list of 61 genera and 102 species of woody plants of the Miami country was the only list of southwestern Ohio plants published before those of John Leonard Riddell (1834–1835, 1836), Thomas Gibson Lea (1849), and Joseph Clark (1852). The only botanical site Drake identified precisely was the falls of the Little Miami River, at which he had seen the rare plants arbor vitae, hemlock, yew, mountain maple, red berried elder, and witch hazel. But at least two other references to Drake's sites appear in the literature. In his reminiscential letters, begun in 1845, Drake (1870a) included his nostalgic recollections of *Claytonia, Pul-*

monaria, Phlox, Trillium, and the mysterious "*Fringillaria*," observed on Cincinnati's Mount Adams more than 35 years previously. Also, Clara Longworth de Chambrun (1933, p. 50), who spent her childhood on her grandfather's suburban estate in East Walnut Hills, left the following testimony:

> The large domain, called "Rookwood," consisted originally of two hundred acres of fine arable ground, pasture land and primeval forests composed of beeches, walnuts, maples, liriodendrons—one hundred species of trees and shrubs according to the computation of Doctor Drake.

In a footnote to his list of woody plants, Drake listed the texts from which he took the scientific names for his list of plants: Humphrey Marshall's *Arbustrum Americanum* (1785), Abraham Rees's *Cyclopaedia* (1802–1820), William Turton's (1806) translation of Linnaeus's *Systema Naturae*, and James Mease's *Geological View* (1807), in the last of which he found Michaux's list of oaks. Drake did not actually see Michaux's *Flora Boreali-Americana* (1803) until his own plant list was in proof.

By 1816, Drake was also familiar with Frederick Pursh's *Flora* (1813), as evidenced by his first exchange of letters with Short (Short 1816; Drake 1817). Also in 1816, Drake sent Short a copy of Correa da Serra's digest of Muhlenberg's catalog (Horine 1961, p. 330). Drake's botanical readings over the years were described in his review of the second edition of A. P. DeCandolle's (1816) essay on medicinal plants (Drake 1828). In addition to the authors already listed, Drake made special note of the writings of Nuttall, W. P. C. Barton, William Darlington, Jacob Bigelow, John Torrey, and Stephen Elliott, and he proclaimed:

> With [Nuttall's *Genera*], and the practical work of Mr. Pursh, and the Elements of Professor Barton, no young man of industry and observation, could be long, in acquiring a competent knowledge of the plants which might surround him.

Drake's (1834b) final review of a general botanical work was his notice of Daniel J. Browne's *Sylva Americana* (1832). In its day, this review must have been a most powerful argument for forest conservation.

In the summer of 1816, Thomas Nuttall visited Cincinnati and Drake arranged a party at which he may have introduced Short and Nuttall (Horine 1961, p. 133; Graustein 1967, pp. 106–107). While in Cincinnati, Nuttall apparently received a specimen of *Erythronium albidum* from Drake and published it as new to science two years later (Nuttall 1818a). Stuckey (1966) has written:

> This specimen [at the Academy of Natural Sciences of Philadelphia] should be regarded as a type, unless there is a Nuttall collection in one of the British Herbaria . . . This is the only Ohio specimen collected by Drake that I know of in the Academy Herbarium.

Soon after Short moved to Hopkinsville, Kentucky in 1817, he received from Drake, now at Transylvania University, a request for specimens of medicinal plants with which to illustrate his lectures in materia medica and medical botany. Short (1817) replied on 31 October, "enclosing him 24 specimens of plants." In 1818, Drake returned to Cincinnati and gave subscription lectures on botany (Horine 1961, p. 153). The first of these, a sententious and fairly insubstantial apologia for that which was to follow, was published in the *Western Spy* for 17 October 1818. In the same year Drake also helped to organize the Western Museum Society and the Cincinnati Society for the Promotion of Agriculture. Stuckey (1969) and Shapiro (1976), the latter of whom perceptively refers to Drake's "entrepreneurial leadership," have outlined Drake's relationships to the Western Museum and its successor, the Western Academy of Natural Sciences. In

November 1818, Nuttall, now on his way to Arkansas, passed again through Cincinnati, visited Drake, and praised him as "one of the most scientific gentlemen west of the Allegheny Mountains" (Nuttall 1821). In a letter to Zaccheus Collins, dated 4 December, Nuttall wrote: "Roots of *Dracocephalum cordatum* . . . I have planted in Dr. Drake's garden" (Nuttall 1818b). In a slightly later letter to Collins, Nuttall (1819) stated that Drake was responsible for obtaining $250 worth of credit toward the expenses of the Arkansas expedition. W. P. C. Barton (1818) also acknowledged Drake as the source of "good dried specimens" of *Frasera walteri.*

The years 1819 to 1826 were a time of economic crisis, as a result of which many of Cincinnati's old guard would spend the remainders of their lives on the verge of poverty. The story of the Panic of 1819 has been told repeatedly in the histories of Cincinnati (e.g., Goss 1912, Vol. 1, pp. 139–142). Its full effects were belated, however, and Drake himself would finally be forced into bankruptcy in 1825.

In May of 1819, the dying William Baldwin passed through Cincinnati with the Long Expedition, botanized with Drake, and left a record of some of the plants they collected in a letter to William Darlington (Baldwin 1819):

> . . . to no one do I feel under greater obligations than to Dr. DRAKE, —whose attention was unremitting,—and with him I rode out daily, when the weather permitted. We met with many interesting plants (several new to me),—and among others, which I select from memory, the *Collinsia*, of Nuttall, *Synandra grandiflora*, Ditto, *Stylophorum diphyllum*, Ditto, *Valeriana pauciflora*, *Hesperis pinnatifida*, Pursh—very different from the southern plant, of MICHAUX.

Later that year Drake (1819) read a paper "Observations on the means and importance of preserving fruit and forest trees" at the first meeting of the Cincinnati Society for the Promotion of Agriculture. Horine (1961) has called this paper the first American discussion of forest conservation.

Davis (1955) has written of the bitterness that Correa da Serra felt toward the United States and particularly its government when he left this country in 1820. Davis added, "Even to his Philadelphia friends he wrote rarely," and stated that during the whole of 1821 Correa appeared to have written only one letter to John Vaughan, out of all his American acquaintances. In this light, the following letter from Correa to Drake, dated 28 January 1821 from Paris, is high praise indeed, and strongly suggests that there was much more to their relationship than has otherwise made its way into the record.

> DEAR SIR AND FRIEND,
>
> Mr. Brogniart, of the Royal Academy of Sciences, a name well known to you for his first rate works on Geology, Mineralogy, and Zoology, wishes to have a scientifick correspondent in the United States, on whose science and correctness he may rely. You know the high opinion I entertain of you in both these points of view; I am consequently very glad to put you in the way to do honour to your country and to yourself, by entering as an ally in the great scientifick confederation. I write this in Mr. Brongniart's cabinet, and he will take care of having this forwarded to you. The complication of business hindered me from writing you a farewell letter when I left the U.S.; but you see that I conserve every where the sentiments of friendship, esteem, and consideration, with which I am, most sincerely yours. . . .

Under this cover, Alexandre Brongniart enclosed his "Circular relative to the manner of collecting, labelling, and conveying specimens of fossil organick remains and their accompanying rocks," a translation of which Drake dutifully had subtended to Correa's letter in John D. Godman's Western Quarterly Reporter (1822).

In 1823, Drake was elected to the Transylvania chair of materia medica and medical botany sought by Short (Skaggs 1982, p. 44). Two years later, when Drake assumed the chair of theory and practice of medicine, Short again sought the position in medical botany. However, Drake supported Dr. John Barnes, an old friend from Philadelphia, despite the fact that rumors of a certain extra-marital indiscretion had long since made their way from the east (Short 1818).[4] But the "fix" was already in. Short's aristocratic family had long been connected to Ohio Valley society and to Transylvania's medical department, and amid cries from Short's uncle, Transylvania trustee Charles Wilkins, that Drake used every means "that low cunning & intrigue could do" (quoted by Skaggs 1982, p. 46) to bar the nephew's appointment, Short was elected to the chair that he would fill so honorably until he removed to the Louisville Medical Institute in 1838. Two speculations may explain why Drake went against the grain on this occasion. First, to Drake's perception, Short was well-rooted in Kentucky and would remain and work there, regardless of whether he held a professorship. Drake may have seen an opportunity to provide the western country with yet another representative of that rare species, the professional medical botanist. Second, it is no great secret that Short was a fairly lackluster lecturer, and although Short had no teaching experience at the time, Drake may have anticipated this on the basis of their previous interactions. Thus, whereas Short was undeniably the better botanist, Drake may have felt that Barnes would make the better teacher. In any case, the rift healed quickly. Skaggs (1982, p. 65), drawing from the Transylvania minutes, states:

> At the end of the 1826–1827 school session, the medical faculty met in the library room, where on the nomination of Dean Drake, they unanimously elected Professor Short dean for the next term.

The events of 1825 resulted in a significant change in Drake's career as a natural scientist, and, by extension, in the scientific power structure of the trans-Allegheny region. Short had waged the first successful challenge to Drake's position as the preeminent arbiter of western botany, and Drake would never again take quite the same active interest in such matters. Two other events of 1825 undoubtedly served to confirm him in his temporary abandonment of botany. The first of these was the death from fever of his beloved wife Harriet on 30 September. From this staggering loss he probably took all the more resolve to study the epidemiology of the western country. And then, on 22 November, Drake's kinsman and biographer Edward D. Mansfield (1825) wrote to his father that Drake had taken "the benefit of the Insolvent Law" and returned to Lexington. For Drake there would be no more of the leisurely affluence so often associated with the botanists of his day. Indeed, from the point of view of a botanist, the years immediately following 1825 may be seen as a hiatus. In 1827, Pennsylvania physician-botanist William Darlington, at Drake's suggestion, requested plant specimens from Short, and these two gentlemen would continue to correspond until 1859 (Stuckey 1983). With the exception of his review of DeCandolle's essay in 1828, Drake did nothing more with botany until 1833.

A new generation of naturalists was coming to Cincinnati, and Drake probably made sure that they all knew of Short. Robert Buchanan, Thomas G. Lea, and Joseph Clark arrived in 1822 and 1823. Native Cincinnatian Milo G. Williams took courses from Drake sometime between 1825 and 1829. From 1831 to 1832, John M. Bigelow of Fairfield County was a student at the Medical College of Ohio, and later wrote to Short that he had met Riddell at Drake's home. From 1834 to 1836, John Leonard Riddell, whose relationship to Drake has been summarized by Stuckey (1984), studied medicine in Cincinnati and published his catalogs of western plants. And in 1837, Dr. John A. Warder, who would carry on Drake's work in forest conservation on a grand scale, moved to Cincinnati from the Belmont section of West Philadelphia. Of these men, all but Clark and Warder have extant specimens in the Short Herbarium at The Academy of Natural Sciences of Philadelphia (teste R. L. Stuckey). After 1835, Drake's involvement with the Western Academy of Natural Sciences would have brought him into contact with all of these botanists, with the exception of Bigelow. Stuckey (1984) has summarized additional information on the botanical activities of these men.

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[4] On Barnes, see Drake (1825), Goodwin (1905), Meisel (1926, p. 139), Bauer (1963, p. 24). Barnes eventually settled in St. Louis, and although he taught medical botany there, his absence from the chronicles of Spaulding (1908–1909) and Klem (1914) may well be telling.

The Western Journal of the Medical and Physical Sciences, founded in 1828, would be Drake's great vehicle for the promotion of science. There, in the same year, he published two notices of the work of Short (Drake 1833a, c), of whom he wrote in terms of "unqualified commendation," and two of Riddell (Drake 1833b, d), in the latter of which he acknowledged receipt of "a port-folio of Ohio plants, collected, beautifully preserved, and accurately labelled, by Mr. Riddell, of the valley of the Scioto; to which they are indigenous." Also in 1833, at the forty-fifth anniversary of the first settlement of Cincinnati, Drake delivered his "Buckeye Dinner Speech," a whimsical treatment of the lore of Ohio's botanical nickname.

The first Geological Survey of Ohio was organized in 1835, and Drake may have played a role in Riddell's appointment to that Survey (Drake 1836). In the same year, Riddell completed publication of his *Synopsis of the Flora of the Western States* (1834–1835), first in Drake's journal and then as a separate, followed by the *Supplementary Catalogue of Ohio Plants* (1836), again in Drake's journal and again as a separate. In April 1835, as mentioned, the Western Academy of Natural Sciences was founded by Drake and others, and on the nomination of Drake, Short was elected the first corresponding member of this new Academy (Wood 1835). Drake reportedly made donations of specimens from European plant collectors to the Academy as late as 1838 (Stuckey 1969, 1984; Shapiro 1976).

In 1838, Drake issued a public request for information on the medical botany of Ohio. He also delivered the principal speech at the Cincinnati semicentennial celebration, in which he gave incidental evidence for two otherwise unrecorded prairie sites in early Hamilton County, one just north of Columbia and the other at Ludlow Station, or modern Cumminsville (Bond 1923). In 1840, he reviewed William S. Sullivant's catalog of the plants of Franklin County.

From 1839 to 1849 and again from 1850 until his death in 1852, Drake taught at the Louisville Medical Institute, of which Short was dean, and thus these men were brought again into a close working relationship. At least 32 non-Ohio plants collected by Drake between 1842 and 1850 in the course of his field work in preparation for the *Systematic Treatise* . . . were given to Short and these now survive at The Academy of Natural Sciences of Philadelphia (Stuckey 1969). In 1842, Short sent a small parcel of plants to Dr. George Engelmann of St. Louis by way of Drake (Short 1842).[5] In 1845, Short's letter on the prairie flora of Illinois appeared in Drake's journal. In the same issue, Drake published an article encouraging the "Cultivation of botany by young physicians,'' in which he mentioned Bigelow, Warder, and Riddell, the last of whom he chastised for having ''abandoned the gardens of *Flora* for the smithies of *Plutus*!'' This is a reference to the fact that Riddell had taken a position with the United States Mint in New Orleans. In 1846, Short wrote to John Torrey and enclosed for identification a puzzling specimen of the mint family, collected by Drake in Florida.

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[5] Drake's six letters (in the Engelmann Papers at the Missouri Botanical Garden) to the great St. Louis botanist contain no mention whatever of botany, and I take this as another indication of what I shall call Drake's "deference." Rather, Drake's letters are concerned with obtaining Dr. Engelmann's extended meteorological records for use in the *Systematic Treatise*. . . .

Finally, in his last known acts having to do with botany or horticulture, Drake (1851) lent the prestige of his voice to the call for a public park for Cincinnati, and sent seeds of a tea plant to the Cincinnati Horticultural Society (Anonymous 1851).

PRACTICAL FORESTRY AND HORTICULTURE

Drake had a special love for trees.[6] In 1822, an English traveler, as quoted in the Cincinnati Literary Gazette for 18 December 1824 (p. 194), observed:

> All the land in the immediate neighborhood of Cincinnati is without a tree upon it. This is the case with all American towns . . . When the Americans improve in taste, this indiscriminate destruction of the fine trees will be regretted, for it will take centuries to replace them.

Against this backdrop, Drake in 1819 delivered to the first meeting of the Cincinnati Society for the Promotion of Agriculture, Manufactures and Domestic Economy what Horine (1961) has called ''. . . the first discussion of forest conservation by an American writer. . . .'' However, Drake's theme has more to do with *maintenance* of second growth of economic species than it does with *conservation* of the original silva, as these terms are now used.

Drake made his case in much more forceful terms in his 1834 review of Daniel J. Browne's *Sylva Americana* (1832):

> . . . [I]n many portions, of Kentucky, Tennessee and Ohio, the waste of forest trees has been so unrelenting, that already the children of the first settlers begin to feel the want of them. It is time that every man of taste and science, begin to raise his voice against a practice, which goes to deprive our country of its most grand and beautiful ornaments, augments the heat of its surface, diminishes the quantity of rain, promotes evaporation, and exposes man and beast, to the fierceness of a burning sun, the moment they go abroad in the summer. There is reason, moreover, to believe, that the leaves of trees exert a corrective influence on the atmosphere. . . .

In 1821, having recently founded Ohio's first medical college, Drake wrote to Dr. Samuel L. Mitchill of New York:

> I am endeavoring, in common with one of our public spirited citizens, who is an amateur in Botany, to establish a garden for the use of our Medical College. For the promotion of this object, we are desirous of opening a correspondence with such institutions and individuals as may be proprietors of similar establishments.
>
> We shall be prepared hereafter to send away such of the plants of this region as might be desired in exchange for those with which we might be favoured. . . .

In 1824, Drake was somehow involved with Rafinesque's short-lived ''Botanical Garden of Transylvania,'' but the record does not indicate that this involvement extended beyond a subscription (Peter 1905, p. 38). Drake made at least one other horticultural contribution to Lexington. In describing the Presbyterian burying-ground there, G. W. Ranck (1872, p. 39) wrote:

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[6] His scientific interest, if not his aesthetic attachment, was a quite natural extension of Drake's concern with medical topography. Cf. Thompson (1978, 1980), in the latter of which it is stated: ''Quite possibly the matter of linkages between vegetation and climate, especially in regard to forest clearing and its climatic impact, represents mankind's earliest major environmental debate.'' See also Sargent (1982), passim. For a lively general account of forest destruction in the early western country, see Havighurst (1956), esp. p. 119.

> The large trees which now throw so grateful a shade over it, owe their presence to the mournful interest of Dr. Daniel Drake, whose wife was buried there. He raised the means to pay both for the trees and their planting.

Back in Cincinnati, Drake continued his one-man program of tree plantings. Henry Howe (1891, p. 98) observed that:

> Nothing seemed to escape him for the adornment of the city and the comfort of the people. The line of elm trees on the south side of Washington Park were planted under his direction over sixty years ago.

Finally, there is the garbled testimony of Cincinnati schoolgirl Clarissa Gest (1836), who wrote to her brother:

> Had Dr. Drake commenced his garden this corner of the [Cincinnati] College he is still at it there is centre plot round on this is to be a fountain between it & the college is a hotbed it is sodded to represent festoons from the centre and between the festoons is planted full of shrubbery. The young ladies contribute and then each one is entitled to a bridal wreath. Micajah Williams gave $25 towards the railing and Elizabeth has a Sumac & Sarah Ann a European larch [?] in the garden. So they are entitled to any benefit. The upper yard is to be sodded & planted with trees for a play ground. The young Doctors are to tend the plants I believe.

In light of the emerging pattern, one might well imagine that the Cincinnati park, for which Nicholas Longworth had pleaded in vain for so many years (MacMillan 1912), and for which Drake issued a public call in 1851, would have included extensive tree plantings. One might also wonder to what extent Drake's example shaped the thinking of his longtime friend and associate Dr. John Aston Warder (1812–1883), who would devote so much of his later life to the passionate promotion of practical forestry and forest conservation (Banks 1967; Frederick in preparation).

CONCLUSION

Any of the selected historical details recounted here may, in itself, seem rather trivial. Taken together, these details reveal Daniel Drake not as a great practitioner of botany, but as its most powerful Western apologist. He *could* have been more of a botanist; he appears to have had all the requisite sensibilities and powers of discrimination. But medicine—if we hear true report—is a most jealous mistress, and seldom has she taken a more willing partner than Drake. Rather, so far as botany is concerned, Drake, especially in his later years, was a promoter or "booster," a catalyst, a sort of broker concerned with making the best possible matches between whatever better botanists happened his way. Stuckey (1983), in his paper on William Darlington's western botanical correspondents, has assessed Drake's role in our larger history as follows:

> Drake's greatest contribution to botany was his promotion of the subject; this he accomplished . . . by reviewing publications on the flora of eastern North America, by urging the writing of local and regional floras of the Mississippi valley, and by pointing out the necessity for young physicians to study the specialized sciences, especially botany. He argued for the creation of additional professorships in natural history and botany in medical schools.

The magnitude of Drake's early botanical achievements was due largely to his priority and to the absence or default of other botanists; his later attitude appears to have been one of deference, perhaps as he came more and more to appreciate the grandeur of Short's apollonian vision, which served as direction and focus for his own later, limited botanical efforts, and to which he seems to have acted as a conduit for younger botanists of the Ohio Valley.

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Rafinesque's Sentimental Botany: "The School of Flora"

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Between January 1827 and September 1832, Constantine Rafinesque published ninety-six short descriptions of plants, each one illustrated, in the pages of two magazines from the same Philadelphia publisher—The Saturday Evening Post, a weekly periodical, and The Casket; or Flowers of Literature, Wit, & Sentiment, which appeared monthly. He called these pieces "The School of Flora." In his introduction to the "School," he named his audience, "the youths of both sexes," and explained that he would be writing a kind of "floral history" of "pretty Flowers and useful Plants, such as are deemed ornamental and economical (both American and European)." Further, he promised that "every flower will be considered a moral emblem" (The Casket Jan. 1827, 32). From our perspective today, these descriptions constitute Rafinesque's main excursion into the field of sentimental botany, one aspect of the popularization of botany in the nineteenth century.

The study of botany as a pastime became popular in the late eighteenth century in Europe, and its appeal continued well into the late nineteenth century. Genteel Americans were quick to follow the lead of Europeans in this as in other cultural trends, and so the historian of popular culture in nineteenth-century America notes a proliferation of botany books for children and women (those perpetual amateurs). There was a general attitude that knowledge of botany was a necessary component of an accomplished person. A little poem published in Punch and reprinted in The Garden (Feb. 12, 1881) satirizes the concept of botany as one of a young lady's attractions to the opposite sex:

> What reck I though she be fair
> If the flowers are not her care;
> If she ponder not upon
> Many a Dicotyledon; . . . .
>
> She shall calmly learn to state,
> Clover is tri-foliate;
> And describe in words exact,
> Awn and axis, blade and bract;
> So shall I in her sweet presence,
> Find my love hath inflorescence. (194)

Botany became sentimentalized as it broadened its appeal beyond that small circle of science-minded persons (of both sexes). The sentimentalization of botany in Europe has its origins in France, in the writings of Rousseau and Bernardin de St. Pierre, and in Germany, in the work of Novalis and Goethe. It was quickly capitalized on by lesser-known popularizers like Stephanie de Genlis and Charles Malo. One of the typical "botanical works" of the early century in France was Victorine de Chastenay-Lanty's *Calendrier de Flore* (1802–03), a mixture of botanical description, flower legends, and personal emotion which set the tone for countless other flower books of the period (Seaton 1983). These French books had an influence throughout the rest of Europe and in America as well.

Rafinesque naturally had a professional interest in the popularization of botany. At

Transylvania University, much of his income depended on public lectures. In his introductory lecture on botany (probably given in the spring of 1820 according to Charles Boewe), he made every effort to relate the study of botany to practical concerns. He looked ahead to the breeding of better varieties of vegetables and made an eloquent plea for the conservation of maples, similar to that made in Cooper's novel *The Pioneers,* published in 1823 (Rafinesque 1983, 11). While his appeal to his Lexington audience does not draw on sentiment at all, he knew the uses of sentimentalization. He wrote in a letter of December 1, 1819 to Zaccheus Collins, "I am patronized by the Ladies, and must endeavor to please them by telling them pretty things, rather than by displaying too much learning" (Dupre 1945, 16). He no doubt drew on this experience with female pupils in preparing the "School," which combines the appeal to utility with the appeal to the emotions.

The two magazines in which the "School of Flora" appeared are both famous in the history of Philadelphia publishing. Both magazines were published from the same office by Samuel C. Atkinson and Charles Alexander, who founded the Saturday Evening Post in 1821 and The Casket in 1826. Charles Alexander sold out his holdings in The Post to Samuel Atkinson in 1828 and Atkinson himself sold the magazine in 1839 (Mott 1957, IV: 671–76). At the time Rafinesque published in The Post it had four pages and looked somewhat like a newspaper. Most of its contents were lifted from other publications, especially the short items, as was the custom of the times. Rafinesque's little essays usually appeared on a page with advertisements for such products as farm equipment and patent medicines (including Pulmel, Rafinesque's own elixir), along with notices for lost horses, cows, and apprentices. Atkinson and Alexander's monthly, The Casket, was fairly successful under its founders, but when it was purchased in 1839 by George Graham and changed its name to Graham's Magazine it became extremely popular (Mott 1930, 544–46). As befitted a monthly magazine, The Casket was more pretentious than The Post. It had fashion notes from London, some original American short stories and poems, engravings of such important buildings as Congress Hall at Saratoga Springs, embroidery patterns, and in general more content aimed at the female reader. Sometimes Rafinesque's pieces in The Casket were followed by brief extracts on plants or gardening from other sources. One of these, from February 1828, explains that to "increase the odour of roses," one should plant a large onion just where it will touch the roots of the rose bush.

"The School of Flora" is completely documented in Fitzpatrick's *Rafinesque: A Sketch of His Life with Bibliography,* revised and enlarged by Charles Boewe (Fitzpatrick 1982). I have discovered only one error in these listings—item 564 is *Frasera verticillata,* rather than *Cunila mariana.* During most months of 1827, its first year, four pieces appeared in each Casket and, in roughly the same month, the same pieces appeared weekly in The Post. For May and December, there were only three pieces, and there were none at all in October. The 1827 pieces were numbered consecutively, and there are forty-two. In January 1828 a "New Series" was announced, and thenceforth only two appeared each month in The Casket, also appearing in The Post in most cases (the exception is April). There are twenty-four pieces in this Series, bringing the total of the "School" essays at the end of 1828 to sixty-six. That marks the end of the "School" pieces which have moral emblems for each flower. There was no "School" in 1829, and in February 1830 there appeared an item announcing another "New Series," which however was not new, but which was taken from the already published *Medical Flora* (published by Atkinson). From then on, each piece was announced as being from the *Medical Flora*, and indeed the material which appeared throughout 1830, 1831, and 1832 at the rate of one each month in each publication is simply taken right from the *Medical Flora*. Strictly speaking, then, the "School of Flora" as a separate entity in Rafinesque's work ceased in 1828, although his publishers continued to use the old title for the material. So while there are ninety-six pieces in the entire "School" (five of which are the same plant with a different description), it can easily be seen that as a distinct endeavor from the *Medical Flora*, the "School" contains only sixty-six plants.

One of the attractions of the "School of Flora" is its original plates; Rafinesque got good mileage from his plates, using them in the "School," the *Medical Flora*, and *The American Florist*. In his Day Book for January 1, 1832, he listed ownership of 200 woodcuts which he valued at $2400. He had possession of 100, with the rest in the hands of S. C. Atkinson. The present location (if any) of these woodcuts is unknown; some of those held by Atkinson were sold and used in later publications by others.[1] Generally speaking, the illustrations for the first sixty-six plants, those in the original "School of Flora," are less scientific in appearance than the ones used also in his *Medical Flora*. Some are very close to conventional flower pictures, those with no botanical pretensions (for example, the *Primula auricula* and the "pansey"). There seems to have been no attempt to make the drawings uniform in style even when three or four of the plants were pictured together.

It is thought that Rafinesque did many of the drawings himself, although it is not known who did the engravings.[2] However, many others were copied by the engraver from several early sources, either exactly, with minor changes, or as a mirror image. The last type suggests the use of a camera lucida. The sources were Jacob Bigelow's *American Medical Botany*, William Barton's *Vegetable Materia Medica*, and Barton's *Flora of North America*. From Bigelow, Volume I (1817), Rafinesque made an exact copy of *Eupatorium perfoliatum;* a near copy of *Hyosciamus niger;* while his *Kalmia latifolia* is a partial copy and also a mirror image. From Volume II (1818) Rafinesque made an exact copy of *Asclepias tuberosa* and *Gentiana catesbei;* a near copy of *Statice caroliniana*, *Panax quinquefolium*, and *Apocynum androsemifolium;* and a rendering of *Cassia marilandica*. From Volume III (1820) he copied *Ilicium floridanum* with a very slight change; *Nymphea odorata* reversed with a slight change; *Xanthosylon fraxineum* much simplified; and a part only of *Aristolochia serpentaria*. From Barton's *Vegetable Materia Medica* Volume I (1817), he copied *Gillenia stipulacea* with some changes, and his *Sanguinaria canadensis* is a mirror image with a few minor changes. From the same work, Volume II (1818), he borrowed the top portion of *Aristolochia serpentaria* to go with the bottom portion from Bigelow, as well as making simplified versions from Barton's *Cunila mariana* and *Spigelia marilandica*. From Barton's *Flora of North America* Volume I (1821) he made an exact copy of *Hibiscus speciosus*, *Oxycoccus macrocarpon*, *Scutellaria lateriflora*, *Aquilegia canadensis*, and *Pyrola maculata*, with a simplified mirror image of *Andromeda arborea*. There do not appear to be any borrowings from Volume II. From Volume III (1823), the exact copies are his *Gentiana saponaria, Nuttala grandiflora* (*Bartonia ornata* in Barton), *Cypripedium luteum,* and *Ipomea quamoclit,* while his copies with slight changes are *Hepatica trilobata, Cephalanthus occidentalis,* and *Chelone glabra.* There are numerous differences in nomenclature between Rafinesque and these sources, which I have not tried to sort out at all. For use in the "School," the book plates had to be reduced in size, of course, and sometimes the orientation of the plant had to be changed somewhat to fit. He used borrowed material for the early "School" pieces as well as for his *Medical Flora* series.

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[1] This information comes from Charles Boewe.

[2] In the *Medical Flora* (I, x), Rafinesque writes that he drew most of the figures and borrowed a few from Bigelow and Barton. Charles Boewe has shown me a remark from a letter Rafinesque wrote to John Torrey on 12 April 1828, stating "I can engrave myself now, I am engraving on pewter and zinc some plates, for my Monuments of America [.]" However, this does not mean that Rafinesque did the woodcuts for the "School."

While all of the plates after the end of 1828 also appeared in the *Medical Flora,* along with the complete contents of the articles, Rafinesque also used the plates in a less well-known work, *The American Florist,* which is simply a collection of some of the plates he had in his possession. It appeared in two editions in 1832, numbers 606 and 607 in Fitzpatrick, one with eighteen figures, another with thirty-six. I have studied the edition showing thirty-six plates, of which only ten are not found in the "School." In some cases Rafinesque shows different names with the illustrations, though, having changed the names of some plants between the first publication of the plate and 1832. Plants in *The American Florist* not also in the "School" are *Achillea ptarmica, Arctium latifolium, Viola canina, Saxifraga granularis, Barbarea alliaria, Chrysanthemum leucanthemum, Stellaria holostea, Melissa officianalis, Buplevrum rotundifolium,* and *Cardamine pratensis.*

As far as the contents of the "School" articles are concerned, there is a great difference between the early pieces and those from the *Medical Flora.* With few exceptions, every entry in the *Medical Flora* follows this standard pattern: Names and Classification; Description; History; Properties. Some of them have another section, Qualities. In most articles, the Properties part takes up the most space, although this varies. Sometimes Rafinesque speaks about only one species. Other times he describes various other species, as in his piece on *Nymphea odorata* he describes also *N. rosea, N. maculata,* and *N. spiralis.* The other species are usually considered part of the History. These *Medical Flora* pieces have no moral emblems, nor do they contain floral legends or other such material. While the appeal of the *Medical Flora* essays is to usefulness, and thus they would have some popular attraction, their audience is clearly the medical professional. This is a great change from the early pieces, which were addressed to young people of both sexes.

Because fully one-third of the "School" pieces are specifically from the *Medical Flora,* one would expect to find that plants of a useful nature far outnumber other sorts of plants in the entire series. And that is the case. The "School" contains both American and European plants, and Rafinesque often discusses both American and European species in the same article. It also includes a number of plants noted mainly for their garden use or their beauty in the wild. Dividing the plants very generally into American plants of mainly economic interest, European plants the same, American plants of an ornamental nature, and ornamental European plants, we can classify Rafinesque's plants in the "School" as follows:

American, economic interest	39
European, economic interest	12
American, ornamental	12
European, ornamental	24

This adds up to ninety-one different plants (there are five duplicates in the "School"). Plainly, Rafinesque's main interest was in the economic uses of plants, which should not surprise us. However, he was not blind to their beauty or their uses in gardens, and he even recommended the planting of various wild flowers in gardens. Among the popular nineteenth-century plants included in the "School" are the tulip, pansy, periwinkle, moss rose, primrose, water-lily, dandelion, and ivy. There are seven trees and a few shrubs included, also. Among the pretty and familiar American wildflowers he chose the columbine, yellow ladies' slipper, blue gentian, hepatica, mountain laurel, buttercup, bloodroot, and a lesser-known species of trillium. But of course many of the great flowers of the world are missing from the "School," especially the lily and the violet. And there are no daisies, another popular Victorian flower (no matter exactly what plant they meant by the name). Most popular writers about flowers of the period chose flowers for their associations and their popularity, but obviously Rafinesque had other criteria. Side by side with the moss rose and the pansy are comfrey and agrimony. One reader wrote in to Rafinesque suggesting the inclusion of the sensitive plant (*Mimosa pudica*), but although in his response to the letter he discussed various plants which might be called by that popular name, he did not include any of them in the series (The Casket May 1827, 195).

When we look at the contents of his early, sentimental "School" pieces, we find an interesting mixture of material, reminding us of Rafinesque's exotic background and his social accomplishments. Each little essay begins by giving the botanic name, the English name, and the French name of the plant. The plant is described and perhaps the meanings of its Latin names are explained. In keeping with his interest in the medical uses of plants, properties and qualities of the plants often appear. Sometimes—very seldom in fact—he gives bits of floral history, such as a brief account of the tulip craze of the seventeenth century. More frequently he has suggestions for garden uses of the plant. In his piece on the strawberry, he not only recommends a strawberry bed in every garden but also advises that more people ought to grow "monthly" strawberries, perhaps the ancestors of what we call "everbearing" strawberries today. He usually gives the emblematic meaning of the plant in a brief sentence, although sometimes he ventures on a short explanation of the reason for the emblem.

Perhaps the most charming aspect of these essays is his emphasis on picturing the plant habitat. Sometimes we are given information on where the plant can be found growing, such as "on the Ohio and all the western streams" as well as "easterly on the banks of the Potomoc" (this is *Jefferson binata*, American twinleaf). Such descriptions give us a mental image of Rafinesque tramping the woods of eastern North America, perhaps on a fine April afternoon. Other descriptions call to mind the younger Rafinesque the cosmopolitan European, as when he explains that betony "grows all over Europe" and is "an essential border plant, like hyssop and sage," in European gardens. There are occasional little scenes, such as children picking buttercups or blowing dandelion seeds into the spring breezes or lovers exchanging a few pansy blossoms or a bloom of the herb truelove (*Paris quadrifolia*). He suggests burnet for cattle feed and warns children against eating buttercups or green apples.

There is not much similarity between his material and that of the usual sentimental botany. The average writer of such books was either a journalist seeking to capitalize on a popular genre or a gentlewoman finding a way to combine her botanical and literary interests. In these "School" pieces, slight as they are, we see Rafinesque the scientist, the field naturalist, making the kinds of remarks about plants that make sense to him. In contrast, in the average sentimental botany there would be brief botanical description, then much material on floral legends or associations and much quoting of poetry. Rafinesque never quotes poetry in the "School" series, but he does so in a little essay on *Melissa officianalis,* clearly intended to be part of the "School" (it has the moral emblem) which never appeared in either the Post or the Casket, but in The Atlantic Journal & Friend of Knowledge (Fitzpatrick 621). Nineteenth-century readers seemed to value the quoting of little snippets of poetry arranged around a theme. For instance, in a piece about the violet, the typical editor might quote snatches of various poems mentioning the violet. Another common way to work in the poetry quotations was to assign the flower meaning, then quote poetry concerning the meaning. While some of the writers described habitats so as to picture a mid-century rural ramble in the woods, the average flower books of this kind make flowers into a passive, sedentary interest.

The moral emblems in his essays represent an interesting aspect of sentimental botany, the language of flowers. First of all, we need to realize that, in the nineteenth century, the word "moral" was applied far more widely than it is today. It referred to any sort of quality or characteristic of people, rather than ethical matters alone. In fact, it is the attachment of these emblems to his flower essays in 1827 and 1828 that make "The School of Flora" so obviously a work in the sentimental mode. In linking flowers to various qualities, situations, and states of mind, he was following one of the major forms of nineteenth-century sentimentalization of flowers. Given the history of the language of flowers, it seems entirely appropriate that Rafinesque was its first American source—and I think he was that.

The language of flowers has a fairly complicated history (Seaton 1980). Of course flowers have been used as symbols or personified in other ways to represent human concerns as far back as we can go in western literary history. Sometime in the late eighteenth century, flowers began to play a more important role in nature description in poetry and became poetic subjects themselves in a new and different way. Along with that, flowers began to be personified in all sorts of moral and didactic poems, from John Langhorne's *Fables of Flora* (1774) to Maria Montolieu's *The Enchanted Plants* (1800). Also in the eighteenth century, European travelers to Turkey came back with stories of the *sélam,* a communication system in which objects, tied up in a scarf or handkerchief, formed a message. Romantic Europeans misunderstood this concept, which is described in two popular travel books, Aubrey de la Mottraye's *Voyages du Sr. A. De La Mottraye en Europe, en Asie et en Afrique* (1727) and Mary Wortley Montagu's *Turkish Embassy Letters* (1763, written about 1717), thinking of it finally as a language of flowers and imagining it to be a secret code language of lovers. The famous orientalist Joseph Hammer-Purgstall set them straight, or tried to, pointing out that the *sélam* is simply a game. After all, if everyone knows the significance of the objects and a young man has to convey a rather bulky package consisting of such items as fruit, flowers, stones, vegetables, and pieces of charcoal to a forbidden young woman, isn't he running a much greater risk of being caught than if he were carrying a simple note? Hammer-Purgstall reminded his readers that the *sélam* uses flowers among many other things, and the meanings are sound-related rather than symbolic. But in many minds, a connection between the mysterious east and a secret language of flowers had somehow been made (Hammer-Purgstall 1809, I: 32–42).

The symbolic language of flowers as we see it develop in the nineteenth century has its origins in France, during the first two decades of the century. In 1819 it was put into the form which made it so popular, in *Le Langage des Fleurs* by "Charlotte de Latour" (a pseudonym). After that year, it spread rapidly into Germany, England, and ultimately America. There were also many French imitations. There is no single language of flowers. The meanings compiled in the Latour book had the most influence, but every country had its own most popular version, and there were many variations. What is fairly consistent is that the language of flowers is the language of the love affair.

Simply defined, the language of flowers is a list of flowers (often including flowering trees, shrubs, and sometimes fruits and vegetables) attached to a list of meanings. The vocabulary, as it was called, enabled lovers to communicate with one another through bouquets, nosegays, or just single blossoms. There was an elaborate grammar of the language created, so that one could make "written" messages as well as direct ones. As far as I can tell, however, the language of flowers was just as much a game in the nineteenth century as the *sélam* was in the Turkish harems, for there was not much actual use of it. It was mainly a genteel amusement for women, developing into various actual games such as a floral fortune telling game (there were different versions).

The first two American language of flower books both appeared in 1829, Elizabeth Gamble Wirt's *Flora's Dictionary* the first and then Dorothea Dix's *Garland of Flora. Flora's Dictionary* was much more popular and influential than Dix's short work, going through numerous editions. But while honors for the first American language of flower book go to Mrs. Wirt, Rafinesque's emblems in "The School" began fully two years before either of the books appeared, making them, to my present knowledge, the first set of flower emblems published in America and written by an American (or one soon to become an American). Rafinesque's Turkish birth, his French-German parentage, and his professional identity as a botanist make him almost an emblem, himself, of the language of flowers.

Floral emblems were not scorned by all botanists of the times. In those early days of its popularity, the language of flowers was viewed as a harmless, wholesome, and amusing aspect of botanical and horticultural interests. Mrs. Lincoln Phelps added a language of flowers vocabulary to her *Familiar Lectures on Botany* after the publication of the two American books, while John Stevens Henslow, the distinguished British botanist, professor of botany at Cambridge and teacher of Charles Darwin, wrote parts of a sentimental botanical emblem book called *Le Bouquet de Souvenirs* (1840).

When we look at Rafinesque's emblems themselves, we see that they are a bit different from an ordinary vocabulary list. The main difference is that they are very negative, while most language of flower vocabularies stress positive meanings, allowing some negatives. In fact, the emblem set rather parallels Rafinesque's other writings on women, and perhaps even his own rather sad experiences with women. While in Sicily, he formed an alliance with a woman whom he could not marry because he was Protestant; and when he lost his fortune in a shipwreck off Long Island, she left him for another man, taking the children with her. His long poem *The World* has an entire section on women, revealing a chivalrous yet detached attitude. He pictures a few bad women, those who create unhappy homes:

> But there also, if wicked temper comes
> In mood perverse, to drive the happy scene;
> There may arise a hell of doleful woes.
> If rare, it happens still, and men made sore,
> Reject the ties of love, to hatred changed. (195)

In his drawings of Lexington friends, published by Harry B. Weiss in 1936, Rafinesque also included some unpleasant women. Many of the pictures of women are surrounded by flowers, some of them emblematic. Weeping willow and bittersweet, carefully labeled, surround the image of "Juliet," who is further described in a verse,

> I knew her in the prime of her beauty and youth:
> When she was the chaste emblem of candor and truth.
> But alas! what a change! . . .

The floral emblem set in "The School of Flora" contains a number of flowers meaning bad temper, including bittersweet, "inconstancy and bad temper." In all, forty-two of the meanings are negative, while twenty-four are positive. And of the positive ones, many are qualities not especially related to love: industry, gratefulness, strength, wealth, vernal delight, safety, practical philosophy, utility, thrifty and wary state, cordiality, good sense, favorable opportunity. Many of these in fact seem very commercial in meaning. The positive romantic meanings are few—only one dozen in all. Perhaps most telling of all is Rafinesque's emblem for true love—which traditionally is the myrtle, symbol of Venus. For this important meaning, Rafinesque chose the herb paris or herb truelove (*Paris quadrifolia*), a plant of the trillium family. He assigns this meaning on the strength of the European folk custom of lovers presenting it to their beloved. However, as he also explains, we know the herb paris of folklore in quite another association; it is the traditional symbol of good luck, in our culture usually represented by the four-leaved clover.

Rafinesque often makes an attempt to explain his choice of meaning for a particular flower. Of the sixty-six emblems, only two are drawn from tradition, a variety of the rose (moss) representing female beauty and the ivy meaning friendship. In other words, he ignored popular meanings, such as the common equation between the pansy and thought. Some meanings relate to plant appearance, as *Andromeda arborea* (the sorrel tree) means tall nymph or lass of the hills, while *Arum dranunculus* is ferocity. Other meanings relate to the uses of the plant, as *Crategus ocycantha* (hedge hawthorn) represents vigilance and security. Some meanings come from properties of the plant, as *Dionea muscipula* (Venus fly-trap) is the emblem of caution—understandable from the perspective of the fly. *Erysimum alliaria* or stinking gilliflower represents hypocrisy and disguised bad temper, obviously because of its odor.

To give a specific example of how Rafinesque's emblem for one popular flower compares to those of other writers, let us look at the tulip. Rafinesque makes it the emblem of pride. In Latour, Wirt, and other writers, the tulip means declaration of love, probably the most popular meaning for the tulip thoughout the century. In the work of these writers, other flowers represent pride—amaryllis, tall sunflower, crown imperial, and carnation, among others. But Ralfinesque has no flower to mean declaration of love.

Rafinesque's "School of Flora" essays show Rafinesque attempting yet another common pursuit of the early nineteenth-century botanist, the popularization of botany, imitating in many ways, in others going his own way, as he is so famous for doing in his more scientific projects. They tell us something about Rafinesque the botanist, Rafinesque the illustrator, and Rafinesque the man. As an historian of the language of flowers, I am gratified to find that such a suitable person seems to be the first American to popularize this "gentle science"—even if, in his hands, the love affair takes on the coloring of a Sicilian tragedy.

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John Bradbury (1768–1823)—Some Letters and His Irish Connexions

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In the spring of 1809, John Bradbury sailed from the English port of Liverpool for the United States, intent on collecting plants in the central, frontier states. He had persuaded the trustees of Liverpool Botanic Garden to finance his expedition (Rickett 1950; Stansfield 1951; McKelvey 1955), and had also accepted a grant of ten pounds from the Dublin Society which controlled the newly-established botanical garden at Glasnevin, north of Dublin (Nelson and McCracken 1987).

Recently one of us (JP) discovered in the School of Botany, Trinity College, Dublin, a series of letters written during the last decade of the eighteenth century and the first half of the nineteenth century and addressed principally to the Scottish-born horticulturist and botanist, James Townsend Mackay, one-time curator of the botanical garden at Ballsbridge (Dublin) belonging to the University of Dublin (Trinity College) (Jackson 1987, Nelson 1987, Walsh and Nelson 1987). Among the letters were three written by John Bradbury, two addressed to Dr. Whitley Stokes, Fellow of Trinity College and lecturer in natural history, and one to James Townsend Mackay. The text of these letters is transcribed below.

BRADBURY'S IRISH CONNEXIONS

John Bradbury was a native of Stalybridge in Lancashire—he was born on 20 August 1768 (Stansfield 1951). As a young man, he worked in the cotton mills of northern England. He was married perhaps in the mid-1780s, and by 1809 he and his wife, Elizabeth, had a family of eight; at least the eldest boy was then old enough to have accompanied his father to America.

John Bradbury developed a keen interest in natural history; he was elected a Fellow of the Linnean Society of London and had collected plants in Cheshire before 1805. He was friendly with William Bullock, goldsmith and museum proprietor, whose famous Museum of Natural History flourished in Liverpool between 1799 and 1811—during the 1820s Bullock also, coincidently, travelled in North America and Mexico.

The Bradbury family had connexions with Ireland. For not less than fifteen months between September 1810 and December 1811, Mrs Elizabeth Bradbury and the younger children lived in Cork (Rickett 1950); a plausible explanation is that she moved there to her parents' house to save the expense of running a home in England during her husband's adventures overseas—thus the address on her letter (11 October 1810) to William Roscoe (see Rickett 1950; 68)—Mr Samuels's Moores Street Hammonds Marsh—is perhaps that of her father; unfortunately no documents have been traced to confirm this supposition.

If there was a close familial link, it is possible to explain various references in early

Irish floristic works to a Mr. Bradbury[1] by suggesting that the collector was John Bradbury and that these plants were gathered on one or other occasion when he was visiting his wife's family in Ireland.

In Walter Wade's *Plantae rariores in Hiberniae inventae* (1804) two bryophytes are attributed to a Mr. Bradbury; 'Bryum flexuosum' (entry no CCLXXII) was collected on the north-western side of Cullenagh Mountain, and 'Hypnum stramineum' (CCLXXV) at 'Cloposk', both near Stradbally, County Laois (formerly Queen's County). Bradbury also provided Wade with specimens of 'Lichen miniatus, gray cloudy Lichen' (CCCLXXV) from 'Clopook, between Athy and Stradbally' (Wade 1804).

In James Townsend Mackay's first botanical publication, *A systematic catalogue of rare plants found in Ireland* (Mackay 1806), there are several other Bradbury records from the same localities on the borders of counties Laois and Kildare. These are [modern names in square brackets]:

XIII. Scirpus multicaulis [*Eleocharis multicaulis* (Sm.) Desv.] . . . near Cullenagh, Queen's county, where it was pointed out to me by Mr Bradbury
{XXVII. Bromus arvensis [*B. arvensis* L.]}
XXIX Bromus pinnatus [*Brachypodium pinnatum* (L.) Beauv.] . . . in hedges near Cullenagh, Queen's county; Mr Bradbury.
{LXXXI. Rubus caesius [*R. caesius* L.]}
{CXXXII. Hypericum dubium [*H. maculatum* Crantz]}
CXLVII. Satyrium albidum [*Pseudorchis albida* (L.) A & D Love] . . . In a field between Cullenagh and Stradbally, Queen's county, pointed out to me there by Mr. Bradbury.
CXLVIII. Ophrys cordata [*Listera cordata* (L.) R. Br.] . . . in a bog, near Cullenagh, Queen's county; Mr. Bradbury.
CLI Serapias palustris [*Epipactis palustris* (L.) Crantz] . . . Plentiful in low marshes, Queen's county; Mr. Bradbury
CLIV. Carex stellulata [*C. echinata* Murray] . . . Near Cullenagh, Queen's county; Mr. Bradbury
CLV. Carex curta [*C. curta* Good.] . . . In a moist meadow, between Cullenagh and Stradbally, where it had been previously observed by Mr. Bradbury.
{CLVIII. Carex intermedia [*C. disticha* Huds.]}
{CLIX. Carex vulpina [*C. otrubae* Podp.]}
CLXIV. Carex pallescens [*C. pallescens* L.] . . . Found in moist grounds between Cullenagh and Stradbally, in company with Mr. Bradbury.
CLXIX. Carex pilulifera [*C. pilulifera* L.] . . . Near Cullenagh, Queen's county, Mr. Bradbury.
{CLXXI. Carex recurva [*C. flacca* Schreber]}
{CLXXIV. Carex vesicaria [*C. vesicaria* L.]}
{CLXXXII. Humulus lupulus [*H. lupulus* L.]}
CLXXXVII. Osmunda lunaria [*Botrychium lunaria* (L.) Swartz] . . . on a moist bank between Cullenagh and Stradbally; Mr. Bradbury.

None of the Bradbury records given by Mackay (1806) is dated, but *Bromus arvensis* was collected at Cullenagh in July 1805—Bradbury is not, however, cited as the collector.

John Bradbury definitely visited Ireland late in 1808—the precise dates are not known but he must have arrived in Dublin before 10 November. His principal purpose on this occasion was to persuade Irish botanists to support his expedition to North America. Bradbury reported his success to John Shepherd, curator of Liverpool Botanic Garden, immediately on his return to England on 30 December 1808:

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[1] No collector with this surname is listed by Kent and Allen (1984) indicating that no herbarium specimens collected in Britain and Ireland are attributed to anyone called Bradbury. John Bradbury is the only early nineteenth century botanist cited by Desmond (1977). There are herbarium specimens collected by John Bradbury in Liverpool (LIV)—these are North American plants as are specimens in BM, K, PH (Lanjouw and Stafleu 1954).

> I arrived about an hour ago after a much longer stay in Ireland than I either wished or intended, and proceed immediately to Manchester to my family. I think it right thus hastily to inform you as the present medium of cummunication with the Committee that altho' I found the scientific men both belonging to the College and to the Dublin Society extremely favorable to my undertaking, yet nothing has been proposed by way of anticipating funds but what you will see indicated by the enclosed. This aid I much wish to decline, partly out of respect to myself but much more in regard to your establishment whom I think it would be treating with disrespect to suffer the Dublin Society to rank with as Patrons under such circumstances. And if this sum only was necessary to compleat the requisite funds I could raise it amongst the Botanic Societies within the precincts of my own county, chiefly supported by the Weavers from whom I would rather accept it. The board of Trinity College would certainly have contributed something had the matter been *pressed* upon them by my friends and particularly by Dr Stokes who is one of the Senior Fellows & possesses much influence, but as they conceived themselves in trust for the Dead to whom they could not explain motives I thought it would be indecorous to commit my friends by urging the business. The Board have resolved to purchase of everything sent and you are appointed to affix the price . . .

The full text is given by Rickett (1950).

What did Bradbury achieve in Dublin? As far as Trinity College, Dublin, was concerned the Board of the University obviously did not agree to support the expedition with an initial grant—the precise meaning of Bradbury's remark about the Board being 'in trust for the Dead' must remain uncertain but it is surely a sarcastic jibe at the university's government. As for the Dublin Society, it is clear that Bradbury returned to England with a promise of support, and it is known from the Council minutes that a proposal was laid before the Dublin Society on 10 November 1808. According to its archives, the Dublin Society was informed that Liverpool Botanic Garden hoped to form an establishment at New Orleans; Bradbury would be based there while collecting in Kentucky and Louisiana, and he would send living specimens to England. He had asked the Society if it would like to contribute to the costs of this scheme at a rate not exceeding one hundred pounds a year. The same proposition was made to the committee which managed Liverpool Botanic Garden.

From Bradbury's remarks to Shepherd it may be concluded that the Dublin Society agreed, at least tentatively, to this proposal although Bradbury himself was not inclined to accept their offer for, it seems, patriotic and sentimental reasons; in the circumstances it is remarkable that he suggested the scheme to the Society in the first place. Bradbury and the Dublin Society did not make any contract but the Society paid ten pounds towards the expedition's costs and in return received some of Bradbury's American seeds (Nelson and McCracken 1987).

BRADBURY'S CORRESPONDENCE WITH DUBLIN BOTANISTS

Six weeks after leaving Dublin, Bradbury wrote to James Townsend Mackay, informing him about his immediate plans.

> Liverpool 6th Feby 1809
>
> My Dear Sir
>
> I have this Day compleated my arrangements with the General Committee of ye Garden here & the others with Lord Stanley & Mr Philips are in such a degree of forwardness that I expect to sail in 3 weeks. Indeed political circumstances render haste necessary & probably do all I can I must land on British territory.
>
> I have for 10 Days past been employing myself in becoming acquainted with the Flora of North America Marking off in my Copy of Gmelin's Sys. Nat such as are natives of that Region and adding thereto those more lately introduced by Michaux & others, Besides intending not to confine myself to the transmitting of

nondiscripts only, I have had the assistance of M^r Shepherd in marking off in the last Edition of Donn's Catalogue the American Plants already known and attaching thereto the Degree of rarity that is r, rr, or rrr &c Purposing to send of those most rare as I do not see if an opportunity of finding 10 or 20 Plants of *Erythronium aureum Dionaea muscipula* or any other rare plant that I should omit it. In these as well as *non dist^s* (if I am so fortunate as to find any) I expect you will be a customer and I trust you will so far have *fraternized* with M^r Shepherd that your intercourse will be frequent before any of the result of my Labours can arrive In the mean time so Far as is within the limits of your duty keep off buying of the Plants of North America probably it will be for the advantage of your institution that you should do so.

I have a very flattering L^r from D^r Smith inasmuch as he approves highly of my plan & choice of Ground and predicts that I shall add much to science. May God grant that I shall justify his opinion.

My eldest Son (John) goes with me on my first Tour as he Draws. I expect that he will call on you in passing through Dublin in a few Days after you receive this it will be a considerable alleviation of the pangs of seperation from a family which when attended with a *perhaps forever* are bitter.

I shall write to you again before I go & probably in time for your reply, for believe me you stand high in my list of correspondents in the mean time if you write to M^r Turner pray inform him of my address as M^r Stock mentions in a l^r that he had expressed to you a desire to correspond and D^r Smith also mentioned him to me in his Letter in such a way as implyed a wish that such a thing should take place.

Pray give my respects to your Father & sister & Believe me ever yours
John Bradbury

My address is Botanic
Garden here . . .

Bradbury sailed for North America about the end of April 1809, arriving there perhaps in early June (cf. Rickett 1950). Several months elapsed before he wrote again to his English and Irish friends. On 12 August he addressed letters from Monticello, the home of Thomas Jefferson, in Virginia to William Roscoe, James Edward Smith (Dawson 1934) and to Dr. Whitley Stokes; the letters to Roscoe and Stokes are almost identical except that the newly-discovered one to Stokes contains some details of the voyage.

Monticelo n^r Charlottesville Virginia
12 Aug^t 1809

Dear Sir

I write to you for the first time from the seat of M^r Jefferson not having been more than a few Days stationary at any one place since I left England untill now. I had a very tedious passage across the Atlantic occasioned by calms during which I employed myself in examining the different animals which Inhabit *Fucus natans* abundance of which we saw every Day. I made some very interesting discoveries which I have communicated to D^r Smith, those which I consider as of most importance are a testaceous animal (a Turbo or an Helix) which spins a Web & Winds it up again with as much facility & celerity as a spider. The other is an Order of Members in *Vermes Mollusca* say in the Genera *Medusa & Physsophora* which were not before known to exist they are the true tentaculae and those which Linnaeus considered as tentaculae have a quite different use they are to the Animal what the Halteres are to Dipterous Insects and serve to keep it steady in the Water. I found also several new Caneri a new Lophius & a Planaria &c &c. I have been here 10 Days during which time I have scarcely ceased to examine the neighbourhood often accompanied by Col Randolph who married M^r Jefferson's Daughter he is an excellent Scholar & naturalist. I have made out two new Cypripediae two Orchidea of a new Genus by Persoon named Heleborine and separated from Serapias, (one of them a most beautiful Plant) two new Cacaliae a new most odorous Coreopsis and a new Talinum and many others of inferior note of which I am doubtful some of these I have removed into M^r Jefferson's Garden others marked in the Woods are Known to Col^l Randolph therefore if I am lost hereafter they will not. Cap^n Lewis whom M^r Jefferson sent during his Administration to explore the Missouri to its source & to proceed across to the South Sea executed his Mission in masterly stile. He is now Governor of Louisiana & lives at Fort S^t Louis near the Conflux of the Missouri with the Mississippi about 1000 miles from hence to him I will go and shall set off on Foot in a few Days altho much press'd by Mess^{rs} Jefferson & Randolph to stay here a month or two; my first stage will be Louisville in Kentucky a distance of 650 miles through the Wilderness as it is called being over the most rugged parts of the Blue Ridge & the Alleghanies this I expect I may accomplish in 20 Days and expect there to meet my Books, Instruments &c &c which I sent by a Waggon from

Baltimore to Wheeling on the Ohio & so down the River. My reason for being so anxious to proceed Immediately to the Missouri is because I understand that Country has not as yet been explored whereas I find from Michaux's Flora Americana Boreale that Kentucky, the Tennessee & Illinois territory have been by him and I should think I executed my mission badly by contenting myself with gleaning when by a little personal risk & exertion I might be the first Reaper.

If I may judge from what I have already seen there is a grand Field in Louisiana. Whether it will be permitted that I shall explore it God only knows: At present I feel both my Mind & my Body Strengthened by the little trial I have made in walking through the Woods from Baltimore to this place (240 miles) with a Gun on my shoulder under a burning Sun in 7 Days—If I could see my Family some times I think I should be the most Happy Man in existence because gratification neither brings remorse nor destroys hope [after] on discovering a new plant. I feel as much pleasure as an Alderman possibly can when setting down to a city feast & I don't know but in ten steps I may find another.

I have met with two very able naturalists in this country one in Charles Town South Carolina Mons^{r} Frederick Ludovicus Lhermineir [Felix Louis L'Herminier] a Member of the School of Institutes. He wished me much to have accompanied him to Guadaloupe & would have paid any expences but this I could not do. I have promised to meet him in Paris on my return to Europe. The other is Mr Jefferson's Son in Law Col^{l} Randolph than whom I have not yet met a better Scholar a more finished Gentleman or skilful Naturalist and I am proud that both he & Mr Jefferson have requested me hereafter to consider them hereafter as amongst my Friends.

I know Sir you have an aversion to Letter writing but pray let me hear from you if it is through the medium of Mr Mackay whom I wish I had for a companion direct for me *Fort S^{t} Louis Louisiana United States America* and state again precisely & distinctly the points in the growth of Timber which you would wish me to attend to I purpose to collect for you a specimen of . . . [ms damaged] Bark, Leaves, Fruits &c &c of all the Trees . . . that I can. I am happy to hear from Mr [Mackay?] that I have an opportunity of becoming of . . . to great Britain. Cap^{n} Lewis about 2000 [miles beyond] the mouth of the Missouri in Latitude 49° [and in] elevated country & a truly Greenland Cl[imate found] a cultivating Tribe of Indians who had . . . a new species of Zea of Indian Corn . . . most abundantly & would grow in . . . Scotland he says if I can get some & . . . Great Britain it will secure it forever from want *you shall never see me back without it*. Col^{l} Randolph 2 years ago got from India a Pint of the seeds of *Holcus Sorghum* of *Linne* now *Sorghum* vulgare of *Persoon* & has this year about an acre I Rode with him yesterday to see it Some Plants are 14 feet high the seeds are better than Maize & it will yield from 80 to 100 Bushels P^{r} Acre he is also cultivating *Sesamum Indicum* for Oil, both of there will be of Immense benifit to this country.

You will have heard before you receive this of the reopening of the breach betwixt this Country & England I lament it as I consider it as the forerunner of a War which may preclude my return for some years to my Family. Accept Sir my best wishes and thanks and rest assured that should you not again hear from me it is because I am no more but shall in the mean time husband my means here so as to leave funds with my Family to do you Justice after Christmas. My most respectful Comp^{s} to M^{rs} Stokes and believe me

Your Grateful & Obed^{t}
John Bradbury.

The letter to William Roscoe is transcribed by Rickett (1950), while that to Dr. James Edward Smith has not been published.

Leaving Monticello, Bradbury travelled, as planned, to St Louis whence he wrote to Stokes on 7 May 1810, three days before his next letter to Roscoe.

S^{t} Louis 7th May 1810

Dear Sir

In a few days after I wrote you last I left Monticello after being treated by Mess^{rs} Jefferson & Randolf in the kindest manner possible with whom I have promised to Correspond and have commenced to do so. At about 20 Miles distance from M^{t}cello the Blue Ridge commences, from whence having often viewed them & considering them to have a good *Botanic* appearance I determined to proceed on foot I did so Fincastle 115 Miles, here I heard by accident of the Oil Nut (mentioned by Michaux the younger) being in the direction of the Kenhawa river. I therefore determined to cross the Alleghenies to the falls of that River 138 Miles. In this fatigueing march I not only got the Oil Nut but a new & very curious species of Corylus also some fine Magnolias say Macrophylum [& deleted] Auriculata & I got a passage down the Kenhawa to the Ohio at point Pleasant their junction: here I bought a Skiff which is a Small boat worked by one person who has a oar in each hand, in this I rowed myself to the falls of the Ohio (Louisville) 400 miles came to the falls 27 Sep^{r}.

Early in October I fell sick of the Ague called in this Western Country Ague & Fever. it is accompanied by a dreadful Headache & privation of Sleep on the 20 Nov^{r} it did not Visit me as usual & on the 23 I embarked in a family Boat to Sha Shawaney Town about 10 miles below the mouth of the Wabash & 350 from y^{e} falls here I got a horse & crossed an uninhabited country to Kaskaskia 140 Miles Sleeping in the Woods Weather very Cold & frosty got there in 5 days crossed the Mississippi into Louisiana & got to S^{t} Louis on the evening of the 31 Dec^{r} ending my tedious and arduous journey with the year. Altho in about Lat. 38° 28′ the Winter is more severe than in Dublin. the Mississippi which is here a full miles across & Very Deep & rapid being often frozen over so that the Illinois people drive their Waggons over the Ice on this acc^{t} I could do nothing at my Garden untill about the Middle of February. I fixed myself at a Mr Berrys about 3 miles from Town who has a plantation on the Priarie [sic]. I must here observe that from the Wabash westward to even the Pacific this country abounds with Natural Meadows of from one Hundred to many Hundred thousand Acres in extent. I therefore during that time & since occasionally employed myself in Collecting Birds in which I think I have been tolerably successful having n^{r} 70 species 19 of which I must consider as new two *Anates* Ducks very beautiful. The Vegetal Kingdom is so compleatly dormant during winter that not a single Flower [plant deleted] made its appearance untill the beginning of last Month consequently I had time to prepare my Garden & Sow the Seeds I had collected last Autumn (about 90 species). What they are I must ascertain when their characters become unfolded: I can now ascertain my discoveries as I proceed as far as the last Edition of Systema Natura Walters Flora Car[oliniana], & some farther Knowledge of my own reach. I count upon *Ribes, Phlox, Viola, Cardamine, Cypripedium* in each 2 species. Some of them very beautiful. A fine species of *Podalyria* with two plants each of which will form a new genus in *Didynamia Angiospermia*, an *Erigeron* and what I esteem very much a beautiful species of *Lithospermum* with orange / col^{d}/ flowers which I have no doubt is the plant from the root of which the Indians procure the red Dye with [which deleted] which they tinge the animal substances say Hair, feathers, &c & that decorate their *Calumet Wampum* Belt Quivers &c & with which they paint themselves red: the colour is equal to that of Carmine.

On the 13h of last month I set out with an intention of exploring the head of the Menrimai River & to meet the Gasconade about 200 miles above its entrance into y^{e} Missouri, but we (I took a guide) were obliged to return after being in the Woods 6 Days as the Osages a Gigantic tribe of Indians were driving back the American Hunters, on some tremendous Cliffs about 60 Miles above the mouth of y^{e} Missouri I found a new Grape which I think will come to perfection with you as the fruit is ripe here by the end of May. Having swam & forded several rivers in my short journey I am again visited by the Ague but after about 6 returns have cured myself with Calomel Bark and Laudanum I *suppose* as it did not come this Day as usual. I hear of several species of Grapes & Plums which from description must be new & highly Valuable, one a grape at the Mandan Nation 1600 miles up the Missouri as represented to me by Mons^{r} Pierre Choutouce a French Trader who has been there is extremely fine & several of the Traders have spoken to me of a delightful Plum which grows up the Missouri about 700 miles in the Priaries on a shrub about the thickness of a finger the fruit large as an hens Egg. If I can procure it no other way I will go for it. I trust that [before] in Autumn I shall be able to send you a copious list of new Plants in the mean time I purpose that you shall hear from me several times. 17th When I said I had cured myself I mistook the matter very much I have been very Sick since the Seventh when I began this Letter. I trust however it is now leaving me. I think I mentioned to you in my last a variety of Zea Mays which Mr Jefferson thought would grow well in England. I have got a quantity of it and it is planted it comes from the Mandan Nation mentioned above and will here produce two crops in a year and I have now no doubt will grow well in Ireland. I shall send several Bushels to Mr Roscoe this Autumn. I have just received a Letter from the Committee of the Liverpool Garden or rather from Mr Roscoe conveying their highest approbation of my proceedings which is highly gratifying You may expect to hear from me f . . . [ms damaged] that I am stationary for the pr . . . st close. With my best respects to M^{rs} Stokes and pray Sir remember me to M^{r} Mackay who I wish was with me to share my *pleasures not my troubles*

I am Sir most gratefully
Your Obedient Servant
John Bradbury

The last of the letters was also written from St Louis, but unlike the two earlier ones it was not a mere repetition of a letter to William Roscoe; there is no letter with the same date and contents among the Roscoe correspondence transcribed by Rickett (1950).

St Louis Louisiana 24th Aug^{t} 1810

Dear Sir

I wrote to you in the Month of May, to which I refer you for an acct of my proceedings up to that time, since then I have been considerably impeded in my researches by sickness as the Ague remained with me untill the beginning of this Month, when it left me seemingly more overcome by my constitution than Medicine as it died away gradually and I trust therefore will not return. But notwithstanding this obstacle I have seen sufficient of this country to cause me totally to retract my opinion of it as expressed to you in my last; I then thought it might soon be explored. I now find it so various in its productions, that I never enter a Priarie for the first time without finding some Plant or Plants that I had not before noticed and I now think my life will be too short to exhaust it.

Before I attempt to give you some account of my Success, I think it necessary to inform you that in a Botanic point of View this country may be divided into three distinct classes, say the Alluvion of the Rivers, the level Priaries and the ridges which divide the head waters of the Rivers called here the Flint hills or knoles. As I live amongst the Priaries my sickness has caused me to confine my researches chiefly to that class of ground and the Flint hills even within 20 or 30 miles of me remain as yet almost unexplored: I have sometimes visited the Alluvion of the Mississippi and the Missouri on the latter I have found a new species of *Celtis* differing considerably from *Celtis* occidentalis which also grows here in plenty. My whole catalogue of such Plants as I cannot reconcile to any description in the Systema Natura amounts to 73 out of which I count upon Nine new Genera, one which I discovered two days ago would in Natural Order be a *Nymphaea* and indeed when I first saw it I took it for a Yellow Water Lily, but the Calyx is three leaved, Petals three germ becoming a many celled many seeded [capsule] Pericarpium it is in *Polyandria* Polygynia. I have found an *Agave* which I think cannot be *Virginicum* scape simple edges of the leaves with pellucid teeth standing at right angles with the edge. It is nearly as high as my head when on Horseback. I have a *Rudbeckia* much handsomer than R. *Purpurea* Stem leafy many flowered, leaves broad lanceolate toothed, flowers large, Purple. We have a new Species of *Spiraea* here much used by the Indians as a Cathartic & Emetic and also by the back Settlers who call it *Ipecac*. It is a very different Plant from *Spiraea trifoliata*. We have also a Plant the root of which is much used westward of the Alleghanies as a tonic & bitter it is commonly called *Columbo* root, but is not the true Columbo which probably is a *Lopezia*, this is *Frasera Walteri* of Michaux and most of the Physicians of this country think it possesses qualities equal to the true Columbo. As I have not room here to particularize one fourth of the plants which I deem new and as I shall send a plentiful supply of them to Liverpool this Autumn I must refer M^{r} Mackay to M^{r} Sheppard [sic] who will have a catalogue of specimens & discription of all as well as the roots. I expect to be able next Autumn say of 1811 to be able to send more plentifully and a much greater variety as I am in treaty for a piece of ground near S^{t} Louis whereon to establish a permanent Garden in which I will so [sic.] the Seeds of & cherish all the interesting and valuable Plants I can collect it is necessary to collect them as much as possible into one focus! I have already collected the seeds of such as have come to perfection which I shall commit to the Earth Shortly.

General Clarke the companion of Lewis in the expedition from S^{t} Louis to the Pacific Ocean arrived here from the Federal city about a Month ago. I see him frequently and about three days since he shewed me some specimens of Forest Trees from the Rocky Mountains at the head of the Missouri among which I recognized *Cupressus Columnaris* which he informs me grows there to above 350 feet in heighth [sic]. I learn from him also that the Indians on the North West Coast peel & eat the stalks of several species of *Helianthus*. Of the useful Plants which I shall be able to introduce the Variety of Maize from the Mandan nation of Indians as yet seems likely to be the most Valuable but I am much inclined to think that the Summer Grape of this Country would succeed well in Great Britain. We have here a number of settlers from Kentucky who agree in thinking it a different & better Species than the Summer Grape of those parts of which *Michaux* who travelled thro' Kentucky 5 years ago says "Les Grappes en sont aussi grosses et les raisins d'une aussi bon qualite que ceux des Vignes des environs de Paris, avec cette difference que les graines en sont moins serres" I shall send about a Bushel of the *Mandan* Corn & a good supply of the Cuttings & Roots of the Summer Grape. We have another species of Grape which produces a very good fruit and is I believe entirely new as I never either heard or read of a Vitis which had so strange an Habitat. I found it about a fortnight ago in the Bed of a Rivulet on the dry beds of Gravel on which it runs prostrate and sends forth roots at the joints, the leaves polished and resembling those of *Populus dilatata*. It was more than 60 miles from my Garden where I found it however I cut off above & below the joints and brought home in my Saddle Bag Eight roots but on account of the heat of the weather and its singular habit with little hope of its growing with me. I am agreably surprized by 5 out of the eight sending forth young shoots Vigorously I shall go again for it & some other Valuable Plants next month. We have another vine which will I think belong to the genus *Ampelopsis* of *Michaux* I think it new but not being yet possessed of the Flora Americana Borealis I cannot be certain but will send roots of it along with the others at all events the discription of it is–Flowers Polygamous Female & Hermaphrodite corol, reflected Racemes bifid one part again divided leaves heart shaped truncate at the base. I shall be much obliged if M^{r} Mackay will write to me a very long Letter and say if he thinks these vines discribed Our Summer Grape has leaves heart shaped others 3 lobed others 5 and some 7 lobed very pubescent on both sides. I have two Grasses which will each I think form a new family one in Triandria (an elegant grass) the other in Monoecia.

In regard to my future movements I can see but a short way before me I feel that I was created for the avocations which I now follow and therefore shall continue to pursue them for life if they will yield me support to which the fine harvest which I am now certain this country will afford is no little inducement added to which it is perhaps the best Country in the World for a Poor Man to Settle in. Land comparable only to a rich old Dunghill is only 2 Dollars p^r^ Acre for the purchase for ever Millions of Acres of unappropriated Priarie are now covered with grass equal to a Meadow in Great Britain of which a labouring man with one years Wages besides his support can purchase 90 Acres, he receives here ½ a Dollar a Day besides support which will purchase 20 Pounds of Beef or Pork or 25 Pounds of Flour or a Bushel of Wheat.

As my engagements terminate in about 16 months and it takes 8 months or at least 7 to send [letters] to England and receive an answer I have little hope of being able in the mean time to form new ones in Great Britain as excepting Liverpool I find no Public establishment the directors of which look on my undertaking in the same light that I do. I contend that if 60 out of the 73 plants which I expect to send prove new the Liverpool Garden will in this Year have done more for science that all the Botanic Gardens in England besides. When I look at the different catalogues and find only a repetition of the same Plants I cannot help thinking of the Batchelor mentioned I think by Pope who could think of no possible way of enlarging his Dinner but by a multiplication of Legs of Mutton & Puddings.

From the above circumstances it is very probable I shall be in Europe in about 18 months say in France where there is a much greater probability of my meeting with support than in Great Britain of this I was assured by a French Naturalist [F. L. L'Herminier] whom I met in Charles Town deputed by the School of Institutes under the protection of which he offered to place me but my engagements did not permit.

Inclosed I send you some wool which is produced by the Buffaloe on the Immense Priaries from 1600 Miles above this to the Stoney Mountains at the Head of the Missouri. I am informed by the Hunters & Indians that it might be procured in quantities at a cheap rate I think it would make good cloth if you think proper you may shew it to some of the principal clothiers in the Liberty [part of the old city of Dublin] if they think it an object I will give them what information or assistance is in my power. the intercourse betwixt this place & Orleans is as easy as betwixt Dublin & Liverpool and much more safe. I am preparing for you some observations on the growth habitat choice of soil &c &c of American trees which I cannot put out of my hands untill my judgement is more matured.

I am Sir your ever
grateful
John Bradbury

P.S. Joseph Charless Printer of the Lousiana Gazette is anxious that enquiry should be made if his Mother is still living of which information may be had from the Person with whom he served his apprenticeship John Charurier No 132 Capel S^{t}, or of John Robinson Notary Public Crampton Court. If Sir Mr Mackay would make this enquiry before he writes to me I should be much gratified.

The letter was posted on 30 August, and bears a further date stamp reading 'AMERICA OC 24 1810.'

Bradbury and the Glasnevin Botanic Garden

Bradbury's visit to Dublin in the autumn of 1808, before his departure for America, did result in some form of contract with the Dublin Society. In a letter dated 10 May 1809, the head gardener John Underwood informed John Foster that

> Mr Bradbury who is gone to America . . . will supply the Dublin Society with plants, & I have given him a list of 525 sorts, two plants of some sorts, for & six of others, but perhaps it will be a long time, before that any of them come to the Garden . . . (Underwood 1809)

Just over two years later, on 13 June 1811, the Professor of Botany to the Dublin Society, Dr Walter Wade, wrote to Foster enclosing

> a letter from M^{r} Bradbury with a list of plants sent to Liverpool Botanical Garden from America—my rever'd Patron [John Foster] perhaps may recollect that through His interference, the Society two years ago, advanc'd M^{r} Bradbury twenty pounds. (Wade 1811)

The minutes of the Society record that on 23 January 1812 seeds from Louisiana were purchased. As no records of accessions to the Gardens for this period have survived (cf. Nelson and McCracken 1987), it is impossible to report that the seeds from Louisiana arrived at Glasnevin. Indeed there is no other record of contacts between John Bradbury and his Irish correspondents.

However it may here be noted that Bradbury did have an unexpected meeting with an Irishman in America. The story of John Coulter (his surname was rendered as Colter by Bradbury), one of Lewis's and Clark's party, was told by Bradbury (1817). Coulter was captured by the Blackfoot Indians but cunningly escaped and although naked and wounded he managed to reach St Louis where, in May 1810, he met John Bradbury. The Newry Magazine, a little-known, short-lived periodical (see Collins, Nelson and Scannell 1986) published in the town of Newry, County Armagh (Northern Ireland), picked up this story and republished it under the by-line 'The Hunter Hunted.' In a foot-note to it, the magazine's editor commented that John Coulter ' . . . is brother to James Coulter, of Cranmeen, near Newry,' thereby establishing Coulter's Irish connections.

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Bartonia No. 54: 116–123, 1988

Flowering Plants Recorded in Greenbrook Sanctuary, 1946–1986, Exclusive of Grasses, Sedges, and Rushes

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Situated on top of New Jersey's world-famous Palisades, in the boroughs of Tenafly and Alpine, the 165-acre Greenbrook Sanctuary is part of the Palisades Interstate Park. In 1946 it was set aside by the Park as a special-use nature reserve to be administered by the non-profit Palisades Nature Association. For the past 40 years, Greenbrook has functioned as a sanctuary for plants and animals; an outdoor laboratory for field studies on the region's flora, fauna, geology, and changing ecological communities; a refuge for hikers, photographers, birders, and other outdoor-lovers; and especially an outdoor environmental education facility for people of all ages. Access to the sanctuary is via a locked gate (off route 9W) to which members of the Palisades Nature Association (about 3200) are issued keys for $20 per year. A full-time professional naturalist and a weekend assistant conduct nature programs every Saturday, most Sundays, and spring weekdays for members and guests, as well as for outside groups by appointment.

Elevations in the sanctuary range from 280 to 420 feet with several magnificent vistas along its 1.5 miles of cliff edge. Other natural features include several streams which flow eastward through the santuary's forests and tumble hundreds of feet over the diabase cliffs into the Hudson River. One of these streams, Green Brook, has carved out a spectacular ravine for 250 feet above the Hudson. The Sanctuary also contains an artificial 5-acre pond and a small adjoining sphagnum bog, created in 1948 by Guy Nearing to increase the diversity of habitats, plants, and animals representative of northern New Jersey.

The ridges, knolls and sunny hillsides of the sanctuary are characterized by a mixed-oak forest (*Quercus rubra, alba, prinus, velutina,* and *coccinea*), associated *Carya tomentosa, C. glabra,* and *Betula lenta,* as well as some species which become more common in lowland habitats. The understory of these upland forests contains *Cornus florida* and *Hamamelis virginiana,* and saplings of oaks, hickories, and birch. The dominant shrub is *Viburnum acerfolium* with various members of the Ericaceae (see flora list) also common.

On cool, moist, shaded slopes and in fertile coves and stream valleys, *Acer saccharum, Fagus grandifolia, Betula lenta, Liriodendron tulipifera,* and *Fraxinus americana* are common, with dense groves of *Tsuga canadensis* spreading out of the more steep-sided ravines and north-facing slopes. In swamps, streams, and along the banks of the pond and woodland "kettles," the dominant trees are *Acer rubrum, Liquidambar styraciflua, Ulmus americana, Fraxinus americana, Fraxinus pennsylvanica, Nyssa sylvatica, Quercus palustris,* and some *Carya ovata* and *C. cordiformis.* The understory in these wetlands contains *Carpinus caroliniana,* and *Alnus serrulata,* while the shrub layer is comprised of dense thickets of *Lindera benzoin, Clethra alni-*

folia, Sambucus canadensis, Vaccinium corymbosum, Cornus amomum, Cephalanthus occidentalis, Rhododendron viscosum, Viburnum dentatum, Pyrus arbutifolia, Leucothoe racemosa, and other species.

Talus slopes are dominated by *Betula lenta* associated with some *Tilia americana, Ostrya virginiana, Pinus strobus,* and *Paulownia tomentosa,* with *Hamamelis virginiana, Staphylea trifolia, Sambucus pubens,* and rarely *Cornus rugosa* in the shrub layer.

Typical woody plants of the cliff edge include *Quercus prinus, Carya glabra, Celtis occidentalis, Viburnum prunifolium, Amelanchier arborea, Prunus serotina, Sassafras albidum,* and other "pioneer" species also found in the sanctuary's few clearings and along the trails.

A few of these clearings date back to the 1930's when the southern end of the sanctuary was a base for the Civilian Conservation Corps (C.C.C.). Other "disturbed areas" date back even farther to the turn of the century when there were estates in the northern end of the tract. Some of these areas are being maintained as "meadows" to increase the sanctuary's plant and animal variety.

Finally, there are several openings in the forest which are covered with vines, like *Vitus aestivalis, Rhus radicans, Celastrus orbiculatus,* and *Parthenocissus quinquefolia,* and brambles like *Rubus occidentalis, R. allegheniensis,* and *R. phoenicolasius.*

Since the Greenbrook area was first acquired by the Palisades Interstate Park in 1917, its woods have been left to grow into fine examples of mature northeastern deciduous forests. Many of the trees exceed two centuries in age, and a few *Tsuga canadensis, Quercus prinus, Q. alba,* and *Acer saccharum* approach 250 years, as determined by core samples taken by the senior author. Trees of *Liriodendron tulipifera* are the largest —10 feet in circumference and 130 feet tall—but specimens of at least 10 other species exceed 90 feet in height.

Many changes have been documented in the sanctuary's forest since the first studies were completed in its early years (Moore 1949 and Collins 1956). Except for a few areas maintained as meadows, most of the other clearings and "disturbed areas" dating from the C.C.C. era have grown into young forests. A study by Rutgers University researchers (Airola and Buccholz 1982), found that over the past 3 decades oaks were being replaced by beech, black birch, and especially sugar maple in many areas of the sanctuary. Natural succession thus seems to be converting some of the mixed-oak forests into northern hardwood forests. Red oak has decreased greatly as a dominant in these woodlands, perhaps as a result of droughts, gypsy moth damage, or some other factors (Stalter and Serrao 1983). More recently, the flowering dogwoods and hemlocks of the sanctuary have been devastated by an anthracnose fungus and a scale insect, respectively, and their future importance in the forests is doubtful.

The following list is based on the senior author's extensive surveys from 1975 to 1986. All areas of the sanctuary were searched during these years at all seasons. Every species of flowering plant (excluding grasses, sedges, and rushes) was recorded, together with its abundance, location, habitat-type, and earliest flowering date (for which records are kept every year). Booklets containing these findings were published by the Palisades Nature Association in 1977, then updated in 1984. This list contains all species found during those 10 years.

In addition, this list contains all species recorded by Dunham et al. from 1952 to 1958 which could no longer be found in the sanctuary during the 1975 to 1986 survey. Many of these "missing plants" were species which were introduced into the sanctuary in the late 1940's and the early 1950's by the local Garden Clubs (under the direction of the P.N.A.) in their diligent efforts to re-establish some of the Palisades flora which they believed once existed here prior to 1946 when Greenbrook became a sanctuary. Most, if not all of these early plantings undoubtedly disappeared over the decades due to natural plant succession or the absence of the required growing conditions.

The list has a total of 665 species which have been recorded on all known records. Today, 522 species are represented.

We wish to express our appreciation to the members and past and present staff of Greenbrook Sanctuary for their encouragement and assistance.

Abbreviations Used in List

SYMBOLS USED (Refer also to "Abundance Ratings" below). + = Naturalized, not native to the Palisades, but now established there and occurring spontaneously. A = Abundant. C = Common. E = Escape, a remnant of an old garden planting before 1946, these are all alien flora; f = Frequent (older lists). FC = Fairly common. M = Missing, a species on Dunham's 1952 list or its 1953–58 Addenda, but not found during 1975–1984; many of these were planted in early years and undoubtedly died out long ago (abundance ratings for these species are in lower case). oc = Occasional (older lists). P = Planted by P.N.A. and various Garden Clubs since 1946, most species are native to this region and may have once occurred in Greenbrook. R = Rare. r = Rare (older lists). S = Shrub. T = Tree. T/S or S/T = Large shrubs or small trees—most commonly occurring form denoted by first letter (Usually not exceeding 25 feet). U = Uncommon. V = Vine (woody). VC = Very Common. VR = Very Rare. vr = Very Rare (older lists).

FLOWERING DATES. Dates given for the herbaceous plants (and 36 of the showier trees and shrubs) list the month followed by the day and represent the flowering date for each species as averaged over the nine-year period 1975–1983.

ABUNDANCE RATINGS (ratings for herbs given before semicolons, woody plants after). VR = under 5; 1–5. R = 5–10; 6–10. U = 11–50; 11– about 25. FC = 51–100; 26–about 100. C = over 100; well over 100, but usually in a specific habitat. VC = well over 100, one of the most numerous plants; well over 100, many habitats. A = very common throughout most of the Sanctuary.

On records kept between 1952 and 1958, the following terms were sometimes used. They appear in this article when a plant recorded then has not been found since record-keeping was resumed in 1975. Such plants are marked "M" (for "Missing"). f = Freqent. oc = Occasional. r = Rare. vr = Very Rare.

HABITAT CODE NUMBERS. 1 = Cliff edge, cliff face. 2 = Upland Woods—generally dry, mixed-oak forests on plateaus, knolls, summits and sunny hillsides. 3 = Talus—rock-covered hillsides; piles of fallen rocks. 4 = Lowlands—moist, shaded, cooler valleys, slopes and coves. 5 = Hemlock groves and ravines. 6 = Swamp—wet lowlands, swamp forests, streamsides, wet woodland trails. 7 = Shoreline, Pond—sunnier wet areas, like pond edges, bog and open water. 8 = Disturbed Areas—roadsides, trails, clearings.

List of Plants[1]

ACERACEAE: *Acer campestre* (T, E), *negundo* (T, VR, but C along Hudson, 8), *pensylvanicum* (T, P), *platanoides* (+, T, U, 2), *rubrum* (T, VC, 03/24, 4, 6, 7), *saccharum* (T, VC, 04/20, 4), *japonicum* (+, T, VR, 8).

AIZOACEAE: *Mollugo verticillata* (FC, 07/05, 8).

ALISMATACEA: *Alisma subcordatum* (FC, 07/14, 7), *Sagittaria latifolia* (FC, 07/22, 7).

AMARANTHACEAE: *Amaranthus retroflexus* (+, VR, 07/20, 8).

AMARYLLIDACEAE: *Hypoxis hirsuta* (C, 05/03, 2, 8), *Narcissus pseudo-narcissus* (E, 03/30).

ANACARDIACEAE: *Rhus copallina* (S/T, R, also P, 8), *R. glabra* (S/T, U, 8), *R. radicans* (V/S, VC, 1, 2, 3, 8), *R. typhina* (S/T, FC, 8).

APOCYNACEAE: *Apocynum androsaemifolium* (U, 06/03, 8), *A. cannabinum* (U, 06/25, 8), *A. medium* (U, 06/10,8), *Vinca minor* (E and spreading, 03/30, 8).

AQUIFOLIACEAE: *Ilex crenata* (S, P), *I. glabra* (S, P, M), *I. opaca* (T, P), *I. verticillata* (S, U, also P, 6, 7), *Nemopanthus mucronata* (S, P, M).

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[1] Nomenclature follows Fernald (1950).

Araceae: *Acorus calamus* (vr, M), *Arisaema atrorubens* (VC, 04/20, 4), *A. dracontium* (P, M), *Calla palustris* (P, and spreading, 05/13, 7), *Orontium aquaticum* (r, M, destroyed by flood), *Symplocarpus foetidus* (VC, 02/28, 6).

Araliaceae: *Aralia nudicaulis* (C, 05/09, 2), *A. racemosa* (U, 07/28, 4), *A. spinosa* (S/T, FC, 8), *Panax trifolium* (C, 04/22, 4).

Aristolochiaceae: *Aristolochia serpentaria* (oc, M), *Asarum canadense* (P, 04/23).

Asclepiadaceae: *Asclepias exaltata* (R, 06/20, 2), *A. incarnata* (FC, 07/08, 7), *A. quadrifolia* (R, 05/28, 2), *A. syriaca* (U, but C outside, 06/14, 8), *A. tuberosa* (U, also P, 06/20, 8).

Balsaminaceae: *Impatiens capensis* (VC, 06/20, 6).

Berberidaceae: *Berberis thunbergii* (+, S, U, 8), *Caulophyllum thalictroides* (R, 04/26, 4), *Podophyllum peltatum* (P, and spreading, 05/08, 4).

Betulaceae: *Alnus serrulata* (S/T, FC, 03/16, 7, 6), *Betula lenta* (T, A, 04/22, 2, 3, 4, 5), *B. lutea* (T, VR, 4), *B. nigra* (T, destroyed by storm, M), *B. populifolia* (T, FC, 8, 7), *Carpinus caroliniana* (T, FC, 6), *Corylus americana* (S, R, 04/01, 6, 4), *C. cornuta* (S, VR, 6), *Ostrya virginiana* (T, U, 4, 3).

Bignoniaceae: *Catalpa speciosa* (+, T, R, 8).

Boraginaceae: *Echium vulgare* (+, VR, 06/18, 8), *Mertensia virginica* (P, 04/08), *Myosotis laxa* (FC, 05/10, 7).

Buxaceae: *Pachysandra terminalis* (Origin unknown, probably P, 04/26).

Cactaceae: *Opuntia humifusa* (P, no bloom observed, 6).

Callitrichaceae: *Callitriche palustris* (FC, no bloom).

Campanulaceae: *Campanula rapunculoides* (+, VR, 07/07, 8), *C. rotundifolia* (R, 07/09, 1), *Specularia perfoliata* (FC, 06/04, 8).

Caprifoliaceae: *Diervilla lonicera* (S, VR, 2), *Lonicera caprifolium* (+, V, M), *L. japonica* (+, V, C, 8, 2), *L. tartarica* (+, S, VR, also P, 8), *Sambucus canadensis* (S, C, 06/05, 6, 7), *S. pubens* (S, FC, 04/27, 3, 2), *Viburnum acerifolium* (S, A, 05/23, 2, 4), *V. dentatum* (S, C, 7), *V. lentago* (S, R, 6), *V. opulus* (+, S, R, also E, 8), *V. prunifolium* (T/S, C, 05/07, 1), *V. sieboldi* (+, S, VR, 8).

Caryophyllaceae: *Agrostemma githago* (+, vr, M), *Arenaria serpyllifolia* (R, 05/10, 8), *Dianthus armeria* (+, FC, 06/09, 8), *Lychnis alba* (+, U, 05/17, 8), *Paronychia canadensis* (U, 08/03, 2), *Sagina decumbens* (r, M), *S. procumbens* (+, C, 06/05, 8), *Saponaria officinalis* (+, FC, 07/07, 8), *S. antirrhina* (U, 06/15, 8), *S. caroliniana* (C, 05/01, 1, 2), *S. cucubalus* (+, VR, 06/20, 8), *S. stellata* (R, 08/05, 8), *Stellaria graminea* (+, oc, M), *S. media* (+, C, 04/13, 8), *S. vulgatum* (+, C, 05/13, 8).

Celastraceae: *Celastrus orbiculatus* (+, V, C, 8), *C. scandens* (V, U, 1, 8), *Euonymus alata* (S, P).

Chenopodiaceae: *Atriplex patula* (vr, M), *Chenopodium album* (+, VR, but common outside, 07/14, 8), *C. ambrosoides* (+, f, M), *C. hybridum* (VR, 08/12, 8).

Cistaceae: *Lechea villosa* (vr, M).

Clethraceae: *Clethra alnifolia* (S, FC, 07/20, 6, 7).

Commelinaceae: *Commelina communis* (+, FC, 06/20, 8), *Tradescantia virginiana* (P, 06/10).

Compositae: *Achillea millefolium* (+, FC, 05/24, 8), *Ambrosia artemisifolia* (U, 08/13, 8), *A. trifida* (R, but common outside, 08/13, 7, 8). *Anaphalis margaritacea* (M), *Antennaria plantaginifolia* (f, M), *Anthemis cotula* (+, VR, 07/08, 8), *Arctium major* (+, VR, 07/30, 8), *Artemisia vulgaris* (+, FC, 08/26, 8), *Aster cordifolius* (C, 09/10, , 8), *A. divaricatus* (VC, 08/01, 2, 8), *A. dumosus* (oc, M), *A. lateriflorus* (FC, 09/10, 8), *A. linarifolius* (P, M), *A. lowrieanus* (VR, 09/20, 8), *A. macrophyllus* (FC, 07/18, 2, 8), *A. novae-angliae* (R, also P, 09/12, 8), *A. patens* (oc, M), *A. pilosus* (U, 09/10, 8), *A. puniceus* (oc, M), *A. schreberi* (R, 08/10, 8), *A. simplex* (FC, 09/20, 8), *A. umbellatus* (VR, 09/20, 8), *A. undulatus* (R, 09/25, 8, 1), *A. vimineus* (C, 09/04, 8), *Bidens bipinnata* (oc, M), *B. comosa* (R, 09/10, 7), *B. frondosa* (FC, 08/19, 7), *Centaurea maculosa* (+, FC, 07/10, 8), *Chrysanthemum leucanthemum* (+, C, 05/25, 8), *Chrysopsis mariana* (P, M), *Cichorium intybus* (+, VR, but C outside, 07/16, 8), *Cirsium arvense* (+, U, 06/18, 8), *C. discolor* (U, 07/30, 8), *C. vulgare* (+, U, 07/15, 8), *Conyza canadensis* (C, 07/25, 8), *Coreopsis major* (VR, U7711, 8), *Crepis capillaris* (+, vr, M), *Erechtites hieracifolia* (C, 08/13, 8, 2), *E. annuus* (C, 06/20, 8), *E. philadelphicus* (U, 05/20, 8), *E. pulchellus* (oc, M), *E. strigosus* (VR, 07/15, 8), *Eupatorium album* (VR, transplanted from outside, 09/01, 8), *E. fistulosum* (U, 07/23, 8), *E. perfoliatum* (C, 07/20, 7, 8), *E. purpureum* (FC, 07/18, 8, 7), *E. rugosum* (VC, 07/26, 8, 2), *E. sessilfolium* (vr, M), *Galinsoga ciliata* (+, U, 06/29, 8), *Gnaphalium obtusifolium* (U, 08/20, 8), *Helenium nudiflorum* (+, R, 07/08, 8), *Helianthus decapetalus* (U, 08/01, 8), *H. divaricatus* (U, 07/15, 1, 8), *H. strumosus* (VR, 08/18, 8), *Hieracium canadense* (VR, 09/08, 8), *H. floribundum* (+, C, 05/21, 8), *H. paniculatum* (FC, 08/14, 8, 2), *H. pilosella* (+, U, 05/23, 8), *H. pratense* (+, FC, 05/20, 8), *H. venosum* (C, 05/28, 2, 8), *Hypochoeris radicata* (+, R, 06/25, 8), *Krigia virginica* (FC, 05/13, 8), *Lactuca biennis* (R, 08/09, 8), *L. canadensis* (U, 08/01, 8), *L. scariola* (R, but U outside, 08/20, 8), *Leontodon autumnalis* (+, oc, M), *Liatris spicata* (8/15, 8), *Mikania scandens* (U, 09/11, 7), *Prenanthes alba* (U, 08/15. 2), *P. trifoliata* (VR, 08/25, 2), *Rudbeckia serotina* (C, 06/20, 8), *Senecio aureus* (VR, 05/12, 2), *Sericocarpus asteroides* (U, 07/08, 2, 1), *Solidago altissima* (FC, 08/30, 8), *S. arguta* (R, 08/14, 8), *S. bicolor* (C, 08/13, 8, 2), *S. caesia* (C, 09/05, 8, 2), *S. canadensis* (oc, M), *S. flexicaulis* (FC, 09/21, 6, 5), *S. gigantea* (FC, 08/10, 8), *S. graminifolia* (C, 07/20, 8), *S. juncea* (VC, 07/16, 8), *S. nemoralis* (FC, 08/30, 8, 1), *S. rugosa* (VC, 08/21, 2), *S. sempervirens* (P, but U along Hudson, 09/20), *S. squarrosa* (oc, M), *S. ulmifolia* (U, 09/04, 1), *Sonchus oleraceus* (+, VR, but uncommon outside, 07/16, 8), *Tanacetum vulgare* (P and spreading, 08/04, 8), *Taraxacum officinale* (+, FC, 04/10, 8), *Tragopogon pratensis* (+, VR, 05/20, 8), *Tussilago farfara* (+, U, 03/27, 8, 3), *Vernonia noveboracensis* (FC, 07/25, 7), *Xanthium* sp. (vr, M).

Convolvulaceae: *Convolvulus arvensis* (+, VR, 07/07, 8), *Cuscuta gronovii* (FC, 08/04, 7).

Cornaceae: *Cornus alternifolia* (S/T, VR, 3), *C. amomum* (S, C, 06/08, 7, 6), *C. canadensis* (S, P, M), *C. florida* (T, VC, 04/26, 2), *C. racemosa* (S, U, also P, 8, 1), *C. rugosa* (S, R, 3).

Crassulaceae: *Sedum acre* (+, r, M), *S. purpureum* (+, U, no bloom, 6).

Cruciferae: *Alliaria officinalis* (+, VC, 04/28, 8, 2), *Arabis canadensis* (VR, 06/10, 2), *A. laevigata* (U, 04/23, 2), *A. lyrata* (FC, 04/11, 1), *Barbarea vulgaris* (+, FC, 04/27, 8), *Brassica kaber* (+, M), *Cardamine bulbosa* (U, 05/02, 6), *C. parviflora* (R, 04/22, 8), *C. pensylvanica* (U, 05/03, 6), *Dentaria diphylla* (P, 04/23, 6), *D. laciniata* (P, 04/23, 6), *Draba verna* (+, C, 04/03, 8), *Hesperis matronalis* (+, FC, 05/12, 8), *Lepidium campestre* (+, U, 05/10, 8), *L. virginicum* (C, 06/05, 8), *Lunaria annua* (+, VR, 05/01, 8), *Nasturtium officinale* (+, U, 05/10, 6), *Rorippa islandica* (R, 06/05, 8).

Diapensiaceae: *Pyxidanthera barbulata* (P, M).

Dioscoreaceae: *Dioscorea villosa* (FC, 07/14, 8, 7).

Dipsacaceae: *Dipsacus laciniatus* (P, 07/18).

Droseraceae: *Drosera filiformis* (P, 07/25, 7), *D. intermedia* (P, 07/31, 7), *D. rotundifolia* (P and spreading, 07/15, 7).

Elaeagnaceae: *Elaeagnus umbellata* (S/T, P).

Ericaceae: *Andromeda glaucophylla* (S, P, M), *Arctostaphylos uva-ursi* (S, P and spreading, 04/21, 1), *Chamaedaphne calyculata* (S, P and spreading, 04/17, 7), *Epigaea repens* (S, P, 04/11, 2), *Gaultheria procumbens* (S, FC, 07/12, 2), *Galyussacia baccata* (S, C, 2), *Kalmia angustifolia* (S, U, also P, 2), *K. latifolia* (S, C, also P, 05/30, 2,4), *Ledum groenlandicum* (S, P, M), *Leiophyllum buxifolium* (S, P, M), *Leucothoe editorum* (S, P), *L. racemosa* (S, FC, 6, 7), *Lyonia ligustrina* (S, FC, 7), *Rhododendron canadense* (S, P, M), *R. maximum* (S, P, E), *R. nudiflorum* (S, C, 05/03, 2), *R. roseum* (S, P), *R. viscosum* (S, FC, 07/01, 6, 7), *Vaccinium angustifolium* (S, U, 2), *V. atrococcum* (S, FC, 7), *V. corymbosum* (S, VC, 04/23, 6, 7), *V. macrocarpon* (S, P and spreading, 06/15, 7), *V. stamineum* (S, FC, 2), *V. vacillans* (S, VC, 1, 2).

Euphorbiaceae: *Acalypha rhomboidea* (FC, 08/02, 8), *Euphorbia maculata* (FC, 05/30, 8), *E. supina* (R, 08/19, 8).

Fagaceae: *Castanea dentata* (T, U, once C, 2), *Fagus grandifolia* (T, FC, 4), *Quercus alba* (T, VC, 2, 4), *Q. bicolor* (T, R, 6), *Q. coccinea* (T, FC, 2), *Q. palustris* (T, U, 6, 7), *Q. prinus* (T, C, 2, 1, 5, 3), *Q. rubra* (T, A, 2, 4, 1), *Q. velutina* (T, C, 2).

Gentianaceae: *Bartonia virginica* (U, 08/14, 7), *Gentiana clausa* (P, 08/19), *G. crinita* (P, M).

Geraniaceae: *Geranium carolinianum* (vr, M), *G. maculatum* (C, 04/23, 4, 2), *G. robertianum* (R, but common below cliffs, 05/13, 3).

Haloragaceae: *Myriophyllum spicatum* (C, 08/15, 7), *Proserpinaca palustris* (FC, 09/01, 7).

Hamamelidaceae: *Hamamelis virginiana* (S/T, VC, 10/12, 2, 3), *Liquidambar styraciflua* (T, C, 6, 4).

Hippocastanaceae: *Aesculus hippocastanum* (+, T, VR).

Hydrocharitaceae: *Elodea canadensis* (oc, M), *E. densa* (+, oc, M), *E. nuttallii* (U, no bloom observed, 7).

Hydrophyllaceae: *Hydrophyllium virginianum* (vr, M).

Hypericaceae: *Hypericum mutilum* (U, 08/01, 6), *H. perforatum* (+, FC, 06/14, 8), *H. punctatum* (U, 07/12, 8, 7), *H. virgincum* (FC, 07/25, 7).

Iridaceae: *Iris germanica* (E, M), *I. prismatica* (P, M), *I. versicolor* (FC, 05/23, 7), *Sisyrinchium* sp. (FC, 05/29, 8).

Juglandaceae: *Carya cordiformis* (T, FC, 6, 2), *C. glabra* (= *C. ovalis*) (T, FC, uplands; U, lowlands, 2, 1, 4), *C. ovata* (T, U, 6, 4), *C. tomentosa* (T, FC, 2, 1), *Juglans cinerea* (T, R, 4), *J. nigra* (T, VR, 8).

Labiatae: *Agastache foeniculum* (R, 07/18, 8), *Collinsonia canadensis* (C, 08/15, 4), *Hedeoma pulegioides* (U, 08/14, 8), *Leonurus cardiaca* (+, R, 06/25, 8), *Lycopus americanus* (U, 08/03, 7), *L. uniflorus* (C, 08/10, 7), *L. virginicus* (C, 07/23, 7), *Mentha arvensis* (U, 07/23, 7), *M. piperita* (+, r, M), *Monarda didyma* (P, 06/15), *M. fistulosa* (R, also P, 07/15, 8), *Prunella vulgaris* (FC, 06/25, 8), *Pycnanthemum incanum* (R, 07/18, 2), *P. tenuifolium* (U, 07/04, 8), *Satureja vulgaris* (vr, M), *Scutellaria lateriflora* (FC, 07/22, 7), *Trichostema dichotomum* (oc, M).

Lauraceae: *Lindera benzoin* (T/S, VC, 04/06, 6, 4), *Sassafras albidum* (T, FC, 04/24, 8, 2).

Leguminosae: *Albizza julibrissin* (+, T, absent after 1983), *Amphicarpa bracteata* (R, 08/21, 7), *Apios americana* (VR, 08/09, 7), *Cassia nicitans* (oc, M), *Cercis canadensis* (T/S, P, M), *Desmodium canescens* (FC, 08/20, 8), *D. glutinosum* (U, 07/14, 8), *D. nudiflorum* (R, 07/30, 2), *D. paniculatum* (C, 08/14, 8), *D. rotundifolium* (r, M), *Gleditsia triacanthos* (+, T, VR, 8), *Lespedeza capitata* (U, 08/26, 8), *L. hirta* (U, 08/19, 8), *L. procumbens* (FC, 08/25, 8), *L. virginica* (R, 09/04, 8), *Lupinus perennis* (P, M), *Medicago lupulina* (+, oc, M), *Melilotus alba* (+, U, 06/20, 8), *M. officinalis* (+, R, 06/05, 8), *Robinia pseudoacacia* (+, T, FC, 8, 1), *Strophostyles helvola* (oc, M), *Trifolium arvense* (+, r, M), *T. hybridum* (+, VR, 06/30, 8), *T. pratense* (+, R, but common outside, 06/04, 8), *T. procumbens* (+, FC, 05/24, 8), *T. repens* (+, C, 05/24, 8), *Vicia cracca* (+, vr. M), *Wisteria sinensis* (V, E, and spreading).

Lentibulariaceae: *Utricularia* sp. (vr, M).

Liliaceae: *Allium tricoccum* (R, 07/07, 6), *A. vineale* (+, U, 06/20, 8), *Asparagus officinalis* (+, f, M), *Clintonia borealis* (P, M), *Convallaria majalis* (+, R, 05/10, 8), *Crocus* sp. (E, 03/13), *Erythronium americanum* (VC, 04/07, 4), *Hemerocallis flava* (E, 05/20), *H. fulva* (E, 06/05), *Hosta caerulea* (E, and spreading, 07/11), *Lilium canadense* (U, also P, 07/01, 6), *L. philadelphicum* (r, M), *L. superbum* (R, also P, 07/15, 6, 7), *Maianthemum canadense* (VC, 05/06, 2, 4), *Medeola virginiana* (R, 05/25, 4), *Ornithogalum umbellatum* (E, 05/25), *Polygonatum biflorum* (C, 04/28, 2, 3, 4), *P. canaliculatum* (VR, 05/02, 4), *Smilacina racemosa* (VC, 05/08, 2, 3, 4), *Smilax glauca* (V, FC, 8, 1, 2), *S. herbacea* (FC, 06/04, 8), *S. rotundifolia* (V, FC, 8, 2), *Trillium cernuum* (P, M), *T. erectum* (P, 04/14), *Uvularia perfoliata* (VR, 05/10, 4), *U. sessilifolia* (C, 04/26, 4), *Veratrum viride* (C, 05/11, 6), *Yucca filamentosa* (E, M).

Linaceae: *Linum usitatissumum* (+, vr, M).

Lobeliaceae: *Lobelia cardinalis* (FC, 07/25, 6, 7), *L. inflata* (C, 07/09, 8), *L. nuttallii* (vr, M), *L. siphilitica* (P and spreading, 08/09), *L. spicata* (VR, 07/10, 8).

Lythraceae: *Decodon verticillatus* (P, and spreading, 07/25, 7), *Lythrum salicaria* (+, U, 07/04, 7).

Magnoliaceae: *Liriodendron tulipifera* (T, VC, 05/22, 4, 2), *Magnolia virginiana* (T/S, P).

Malvaceae: *Hibiscus palustris* (P, 08/10), *H. trionum* (+, vr, M).

Melastomaceae: *Rhexia virginica* (P, M).

Menispermaceae: *Menispermum canadense* (V, U, 3, 2).

Moraceae: *Humulus lupulus* (+, vr, M), *Morus alba* (+, T, VR, also P, 8), *M. rubra* (T (shrub-like), U, 2).

Myricaceae: *Comptonia peregrina* (S, R, also P, 8, 1), *Myrica gale* (S, P, M), *M. pensylvanica* (S, FC, also P, 8, 1, 2).

Nymphaeaceae: *Nymphaea odorata* (P, 07/15).

Nyssaceae: *Nyssa sylvatica* (T, C, 6, 4, 7).

Oleaceae: *Chionanthus virginicus* (T/S, P), *Forsythia intermedia* (S, E), *Fraxinus americana* (T, C, 6, 4, 2), *F. pennsylvanica* (T, FC, 6), *Ligustrum obtusifolium* (+, S, VR, 2), *L. vulgare* (+, S, VR, also E, 2), *Syringa vulgaris* (S, E).

Onagraceae: *Circaea quadrisulcata* (VC, 06/25, 4, 8), *Epilobium coloratum* (U, 08/06, 7), *E. glandulosum* (R, 08/10, 7), *E. hirsutum* (oc, M), *Ludwigia alternifolia* (FC, 07/11, 7), *Oenothera biennis* (C, 07/20, 8), *O. fruticosa* (P, 06/12).

Orchidaceae: *Arethusa bulbosa* (P, M), *Arisaema dracontium* (P, M), *Calopogon pulchellus* (P, M), *Corallorhiza maculata* (R, 07/30, 4), *C. odontorhiza* (r, M), *Cypripedium acaule* (C, 05/06, 2, 5), *C. parviflorum* (VR, also P, 05/08, 4), *Epipactis helleborinus* (VR, 7/15, 8), *Goodyera pubescens* (VR, 07/25, 2), *Habenaria blephariglottis* (P, M), *H. lacera* (VR, 07/08, 6), *H. psychodes* (P, 07/20), *Liparis lilifolia* (oc, M), *Pogonia ophioglossoides* (P, M), *Spiranthes cernua* (P, M), *S. lucida* (P, M), *S. vernalis* (vr, M), *Tipularia discolor* (P, M).

Orobanchaceae: *Conophilis americana* (C, 05/15, 2), *Epifagus virginiana* (FC, 09/08, 4), *Orobanche uniflora* (r, M).

oxalidaceae: *Oxalis corniculata* (f, M), *O. europaea* (+, C, 05/09, 8), *O. violacea* (P, M).

Papaveraceae: *Adlumia fungosa* (vr, M), *Corydalis sempervirens* (P, 05/25), *Dicentra cucullaria* (R, C below cliff edge, 04/10, 1, 3), *D. eximia* (P, 04/23), *Sanguinaria canadensis* (R, also P, 04/15, 4).

Phytoloccaceae: *Phytolacca americana* (FC, 07/08, 8, 2).

Pinaceae: *Chamaecyparis thyoides* (T, P and spreading, 7), *Juniperus sabina* (S, P), *J. virginiana* (T, VR, oc, also P, 8, 1), *Larix laricina* (T, P), *Picea abies* (T, P), *P. mariana* (T, P, M), *Pinus nigra* (T, P), *P. resinosa* (T, P, M), *P. rigida* (T, P), *P. strobus* (T, U, also P, 3, 1, 2), *P. sylvestris* (T, P), *P. virginiana* (T, vr, M), *Thuja occidentalis* (T, P), *T. orientalis* (T, P), *Tsuga canadensis* (T, C, 5, 4).

PLANTAGINACEAE: *Plantago lanceolata* (+, FC, 05/15, 8), *P. major* (+, FC, 06/18, 8), *P. rugelli* (f, M).

PLATANACEAE: *Platanus occidentalis* (T, VR, 6).

POLEMONIACEAE: *Phlox paniculata* (E, M), *P. subulata* (P, M).

POLYGALACEAE: *Polygala lutea* (P, M), *P. paucifolia* (P, M), *P. sanguinea* (vr, M), *P. verticillata* (f, M).

POLYGONACEAE: *Fagopyrum sagittatum* (+, VR, M), *Polygonum convolvulus* (+, oc, M), *P. arifolium* (U, 08/19, 7), *P. aviculare* (+, FC, 06/25, 8), *P. caespitosum* (+, C, 06/08, 8), *P. cuspidatum* (E and spreading, 08/09, 8), *P. hydropiperoides* (C, 08/03, 7), *P. lapathifolium* (VR, 07/15, 8), *P. pensylvanicum* (R, 09/05, 8), *P. persicaria* (+, VR, 07/11, 8), *P. sagittatum* (C, 08/18, 7), *P. scandens* (C, 08/21, 8), *Rumex acetosella* (+, C, 05/06, 8), *R. crispus* (+, U, 06/05, 8), *R. obtusifolius* (+, U, 07/15, 8), *Tovara virginiana* (VC, 08/03, 6, 7, 4).

PONTEDERIACEAE: *Pontederia cordata* (P, 08/01, 7).

PORTULACACEAE: *Claytonia virginica* (C, 04/08, 4, 2), *Ludwigia palustris* (f, M), *Portulaca oleracea* (+, VR, 07/20, 8).

PRIMULACEAE: *Lysimachia ciliata* (C, 06/25, 6, 7), *L. nummularia* (+, VR, 06/15, 2), *L. quadrifolia* (VC, 05/30, 2), *L. terrestris* (U, 06/23, 7), *Menyanthes trifoliata* (P, 05/05, 7), *Trientalis borealis* (P, M).

PYROLACEAE: *Chimaphila maculata* (U, 07/05, 2), *C. umbellata* (r, M), *Monotropa hypopithys* (vr, M), *M. uniflora* (C, 06/25, 2, 5), *Pyrola elliptica* (VR, 06/20, 8).

RANUNCULACEAE: *Actaea pachypoda* (FC, 05/03, 4), *A. rubra* (P, M), *Anemone canadensis* (oc, M), *A. quinquefolia* (U, 04/22, 4, 6), *A. virginiana* (vr, M), *Anemonella thalictroides* (R, 04/25, 4, 2), *Aquilegia canadensis* (R, also P, 04/28, 1, 3), *Caltha palustris* (VR, 04/20, 6, 7), *Cimicifuga racemosa* (VR, 08/01, 4), *Clematis verticillaris* (P, M), *C. virginiana* (V, M), *Coptis groenlandica* (P, M), *Hepatica americana* (P, 03/19, 2), *Ranunculus acris* (+, U, 05/28, 8, 7), *R. arbortivus* (C, 04/25, 6), *R. bulbosa* (+, U, 05/14, 8), *R. ficaria* (+, U, 04/11, 6), *R. hispidus* (FC, 04/27, 6), *R. recurvatus* (FC, 05/08, 6), *R. repens* (+, R, 05/25, 8), *R. septentrionalis* (FC, 05/08, 6, 7), *Thalictrum dioicum* (P, native below cliff edge, 04/23, 3, 4), *T. polygamum* (U, 06/20, 6), *Trollius laxus* (vr, M).

RHAMNACEAE: *Ceanothus americanus* (S, VR, once oc, 1, 3), *Rhamnus frangula* (+, S/T, FC, 8).

ROSACEAE: *Agrimonia gryposepala* (R, 07/15, 4), *Amelanchier* spp. (T/S, FC, also P, 04/20, 1, 2), *A. stolonifera* (S, VR, 1), *Crataegus* spp. (T/S, R; also P, 1, 8), *Fragaria virginiana* (C, 04/18, 8), *Geum canadense* (VR, 06/30 8), *G. laciniatum* (U, 06/18, 8), *Potentilla canadensis* (C, 05/01, 8), *P. fruticosa* (P, M), *P. norvegica* (VR, 06/27, 2), *P. recta* (+, U, 06/02, 8), *P. simplex* (FC, 05/11, 8), *P. tridenta* (P, 05/20, 2), *Prunus avium* (+, T, U, 2), *P. pensylvanica* (T, R, 8), *P. persica* (+, T, M), *P. serotina* (T, FC, 05/19, 2, 8), *P. virginiana* (T, vr, M), *Pyrus arbutifolia* (S, C, 05/07, 7, 8), *P. aucuparia* (T, P, now spreading, 8), *P. communis* (+, T, VR, 7), *P. malus* (+, T, R, 1, 8), *P. melanocarpa* (S, U, 7, 8), *Pyrus* spp. (+, T, VR, also P, 1), *Rosa carolina* (S, FC, 06/07, 1, 2), *R. multiflora* (+, S, R, 06/01, 8), *R. palustris* (S, R, 7), *Rubus allegheniensis* (S, VC, 05/19, 8, 2), *R. hispidus* (S, FC, 7, 8), *R. laciniatus* (+, S, R, 8, 2), *R. occidentalis* (S, FC, 8, 2), *R. odoratus* (S, FC, 06/06, 3, 2), *R. phoenicolasius* (+, S, FC, 8), *R. villosus* (S, FC, 05/22, 8, 1), *Sanguisorba canadensis* (vr, M), *Spiraea latifolia* (S, FC, 07/01, 8, 7), *S. tomentosa* (S, FC, 07/12, 7), *Waldensteinia fragaroides* (P, M).

RUBIACEAE: *Cephalanthus occidentalis* (S, FC, 07/12, 7, 6), *Galium circaezans* (oc, M), *G. lanceolatum* (f, M), *G. mollugo* (+, FC, 06/10, 8), *G. tinctorium* (oc, M), *G. trifidum* (U, 07/10, 7), *G. triflorum* (oc, M), *Houstonia caerulea* (P, M), *Mitchella repens* (C, 06/08, 5, 4).

RUTACEAE: *Phellodendron amurense* (+, T, VR, 4).

SALICACEAE: *Populus alba* (+, T, VR, 8), *P. deltoides* (T, U, 7, 8), *P. grandidentata* (T, U, 8, 1), *P. tremuloides* (T, R, 8), *Salix alba* (+, T, U, 7), *S. babylonica* (+, T, VR, 7), *S. discolor* (T/S, U, 03/24, 7, 6), *S. fragilis* (+, T, VR, 7), *S. humilus* (S, VR, 8), *S. nigra* (T, U, 7, 6), *S. rigida* (S/T, U, 7), *S. sericea* (S, VR, 7).

SANTALACEAE: *Comandra umbellata* (f, M).

SARRACENIACEAE: *Sarracenia purpurea* (P, 05/25, 7).

SAURURACEAE: *Saururus cernuus* (FC, 07/18, 6).

SAXIFRAGACEAE: *Chrysosplenium americanum* (C, 04/25, 6), *Deutzia scabra* (S, E), *Heuchera americana* (P, M), *Hydrangea arborescens* (S, E), *Mitella diphylla* (P, M), *Parnassia glauca* (P, M), *Philadelphus coronarius* (S, E), *Saxifraga pensylvanica* (r, M), *S. virginiensis* (P, native below cliff edge, 04/29, 3), *Tiarella cordifolia* (P, 05/03).

SCROPHULARIACEAE: *Chelone alba* (U, 08/21, 7, 6), *Gerardia flava* (C, 08/03, 2, 1, 8), *G. pedicularia* (vr, M), *G. purpurea* (f, M), *G. tenuifolia* (vr, M), *G. virginica* (VR, 07/14, 2), *Gratiola neglecta* (C, 06/03, 6), *Linaria vulgaris* (+, FC, 07/03, 8), *Melampyrum lineare* (f, M), *Mimulus alatus* (R, 08/03, 7), *M. ringens* (U, 07/27, 7), *Paulownia tomentosa* (+, T, U, 05/09, 1, 3, 2), *Pedicularis canadensis* (vr, M), *Penstemmon hirsutus* (P, M), *Penthorum sedoides* (U, 08/03, 7), *Scleranthus annuus* (+, oc, M), *Scrophularia lanceolata* (vr, M), *Verbascum blattaria* (+, R, 06/12, 8), *V. thapsus* (+, U, 06/25, 8), *Veronica chamaedrys* (+, FC, 05/15, 8), *V. officinalis* (FC, 05/24, 8), *V. serpyllifolia* (U, 5/10, 8).

SIMAROUBACEAE: *Ailanthus altissima* (+, T, FC, 8, 2).

SOLANACEAE: *Lycium halimifolium* (V, E), *Physalis heterophylla* (VR, 08/25, 8), *Solanum carolinense* (FC, 06/09, 8), *S. dulcamara* (+, V, FC, 05/29, 8), *S. nigrum* (+, U, 06/25, 8).

SPARGANIACEAE: *Sparganium* sp. (FC, 07/10, 7).

STAPHYLEACEAE: *Staphylea trifolia* (S, U, 3, 1).

TAXACEAE: *Taxus cuspidata* (+, S, VR, 8).

TILIACEAE: *Tilia americana* (T, FC, 3, 2, 4).

TYPHACEAE: *Typha angustifolia* (r, M), *T. latifolia* (U, 07/05, 7).

ULMACEAE: *Celtis occidentalis* (T, U, 1), *Ulmus americana* (T, FC, 03/16, 6), *U. rubra* (T, U, 3, 2).

UMBELLIFERAE: *Cicuta maculata* (U, 06/25, 6), *Crytotaenia canadensis* (VR, 07/28, 6), *Daucus carota* (+, FC, 07/04, 8), *Eryngium yuccifolium* (VR, also P, 07/01, 8), *Hydrocotyle americana* (f, M), *Ozmorhiza claytonii* (R, 05/30, 2), *Pastinacea sativa* (+, oc, M), *Sanicula marilandica* (R, 06/20, 2), *Sium suave* (f, M).

URTICACEAE: *Boehmeria cylindrica* (C, 07/11, 6, 8), *Laportea canadensis* (U, 08/03, 6), *Pilea pumila* (C, 08/04, 6), *Urtica procera* (FC, 06/25, 8).

VERBENACEAE: *Verbena hastata* (R, 07/20, 8), *V. urticifolia* (U, 07/12, 8).

VIOLACEAE: *Viola canadensis* (P, M), *V. blanda* (P, M), *V. conspersa* (P, M), *V. cucullata* (FC, 04/15, 4, 6), *V. fimbriatula* (FC, 04/20, 8), *V. lanceolata* (P, M), *V. pallens* (FC, 04/22, 6), *V. palmata* (R, 04/25, 2), *V. papilionacea* (C, 04/12, 2, 4), *V. pedata* (P, 05/03), *V. pensylvanica* (P, M), *V. pubescens* (VR, 04/29, 2), *V. rostrata* (P, M), *V. rotundifolia* (P, M), *V. sagitatta* (oc, M), *V. sororia* (oc, M), *V. striata* (P, M), *V. triloba* (U, 05/05, 2).

VITACEAE: *Parthenocissus quinquefolia* (V, C, 3, 1, 2), *Vitis aestivalis* (V, VC, 8, 2), *V. labrusca* (V, FC, 7), *V. vulpina* (V, oc, M).

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Vegetation and Flora of Hopewell Furnace National Historic Site, Eastern Pennsylvania[1]

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Hopewell Furnace National Historic Site includes 350 ha of rolling countryside in eastern Pennsylvania. About three-fourths of the land is forested with secondary and other disturbed forests (Hopewell Village NHS 1979). The site is located in the forest zone described as Appalachian Oak (Küchler 1964) or oak-chestnut (Braun 1950). Extensive and intensive changes in the forests following European colonization included repeated logging in the 19th century and loss of a former dominant forest species, *Castanea dentata,* to an introduced disease in the early 20th century. In some parts of the region, forest composition has been altered by these disturbances to include more *Betula lenta* and/or *Acer rubrum* than before, and such forests are still changing after the disturbances (Russell 1979; Watts 1979).

The landscape, forested and cleared, was an integral part of the Hopewell furnace operation in the late 18th and the 19th centuries, providing charcoal to fuel the furnace, and agricultural products and grazing for the animals used in the furnace operation. Abandonment of the charcoaling industry and much of the farmland from the late 19th century to the present initiated secondary successional changes in the vegetation which continue today. The present vegetation retains keys to its former use and to its future condition, so that analysis of present forest composition allows reconstruction of the past and tentative prediction of changes in the future.

Our objective here is to provide a forest cover map of the National Historic Site, with descriptions of each cover type, and a list of species present. We also suggest factors which may be responsible for the differences among forest stands.

SITE DESCRIPTION

TOPOGRAPHY, GEOLOGY, AND SOILS. Elevation ranges from just over 280 m in the north to 140 m at the low point where French Creek drains the area from west to east (Fig. 1). The topography is most dissected in the south, draining generally east, with one steep hill in the extreme south rising to 220 m.

Topography is closely related to the geology of the area. The northern, south-facing slope is underlain by Triassic conglomerate and shales (Bascom and Stose 1938). The low-lying area drained by French Creek and its major tributary, Baptism Creek, is underlain by Cretaceous dolomite. To the south are crystalline, pre-Cambrian gabbro and gneiss, and a very resistant Cretaceous quartzite (the Chickies quartzite) which provides the basis for the steep hills in the area.

Soils mirror the topography and geology, ranging from deep and well-drained on the

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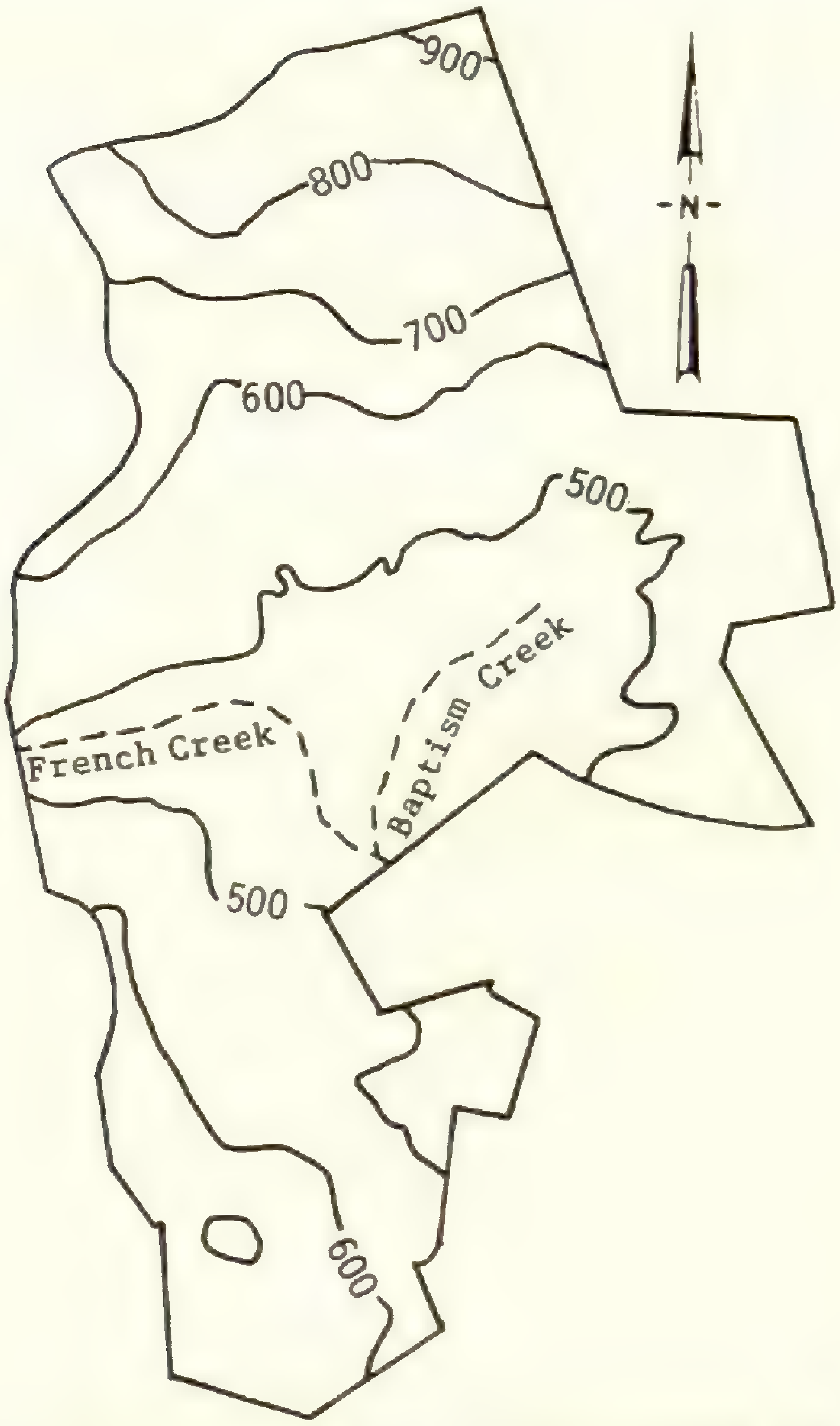

FIG. 1. Hopewell Furnace National Historic Site showing contour intervals in feet and larger streams. Scale = 1:29,000.

gabbro, to deep and poorly-drained along the major creeks, to very stony and well drained on much of the conglomerate of the north (Berks County District 1966, 1976). Some scattered local areas of a hectare or less on the conglomerate and dolomite are virtual rock fields, with no soil exposed at the surface.

Land-use has accordingly followed topography and soils. The steeper, rocky slopes of the north and south were apparently cut over for charcoal rather than being cleared for agriculture. Most of the rest was cleared for agriculture in the past, and in parts drained. Much of this farmland has been abandoned at different times over the past century.

Stone walls and rows of old trees in the forest attest to the past history of cleared fields, some of which had reverted to forest by 1937 (Aerial Photograph 1937). Many fields which are apparent in the 1937 aerial photograph were forested by 1966, when an aerial photograph was taken for a soil survey.

Cutting for charcoal was intensive while the furnace was in operation from 1771–1883 (Hopewell Village 1983). In general, a stand would have been cut at 25–30 year intervals (Hough 1882). All stems in an area were cut, regardless of species. The vigorously sprouting species such as *Quercus prinus* and *Castanea dentata* regrew quickly, as did species which flourish in openings, such as *Acer rubrum* (Society of American Foresters 1954). The extensive cutting for charcoal has left its mark in the numerous charcoal hearths throughout the forest and in the remains of old roads probably used to haul wood to the hearths and charcoal to the furnace.

PREVIOUS STUDY. A map of the vegetation of "the French Creek Project," which included Hopewell, was prepared in 1936 (Stearns 1939). The dominant forest types (based more or less on the Society of American Foresters' classification (Society of American Foresters 1954)) were "even-aged second growth oak consisting principally of scarlet oak [*Quercus coccinea*], black oak [*Q. velutina*], and chestnut oak [*Q. prinus*], white oak [*Q. alba*] and pin oak [*Q. palustris*] being of less common occurrence" (p.1). The report identified two major cover types, scarlet oak-black oak and chestnut oak, plus 8 other types of minor importance, occupying less than 10% of the total acreage, as follows: white oak–black oak, 2%, (2) red maple [*Acer rubrum*]–sweet birch, 3%, (3) red maple–yellow birch [*Betula alleghaniensis*], <1%, (4) red maple–yellow poplar [*Liriodendron tulipifera*], 1%, (5) red maple–pin oak, 1%, (6) yellow birch–yellow poplar, <1%, (7) sugar maple [*Acer saccharum*]–beech [*Fagus grandifolia*]–yellow birch, <1%, (8) black ash [*Fraxinus nigra*]–American elm [*Ulmus americana*]–red maple, 1%.

METHODS

AERIAL PHOTOGRAPHY. In 1986, infrared-color aerial photographs of the site were taken on March 12, before the trees leafed out, and again on August 25, before fall color change, at a negative scale of approximately 1:12,000. False-color prints of these provide stereo coverage for the entire site, at a scale of 1:6,000.

The spring aerial photos, the USGS Elverson 7.5 min. quadrangle topographic map, a 1937 aerial photograph, and a detailed map of the site (scale of 1:2,400) were used in preliminary vegetation mapping and planning. Reconnaissance by road and trail provided further preliminary information for planning the field sampling.

FIELD SAMPLING. Most field sampling in the forested uplands was done by the point-centered-quarter method (Mueller-Dombois and Ellenberg 1974; Avery and Burkhart 1983). Sapling data as well as tree data were collected at each point except where there was no sapling within 25 m of a point because of a low density of saplings. Saplings were defined as tree species <5 cm dbh and >2 m tall, which included most young trees which had not yet reached the canopy, but were well established in the understory or subcanopy.

Lines were run parallel to slopes as much as possible to provide a sample of fairly uniform vegetation for each line, and were spaced to maximize sample variability. The distances between points were generally 50 m except in stands that were too small to provide more than two or three points at this sampling interval; in these, the sampling interval was 25 m. Data from all points along a line were grouped to provide a sample of the vegetation along that line, except where the line crossed an obvious change in prior land-use, signalled by a wall, old road, or other artifact.

The point-centered-quarter method provides an estimate of density (stems/hectare), frequency (proportion of points at which a species occurs), average basal area, and dominance (in basal area/hectare) for each species, as well as total density for each stand. For calculation methods, see Mueller-Dombois and Ellenberg (1974). For saplings, only density and frequency were calculated.

Because of the large number of dead stems, an additional measurement was made in any quadrant in which the tree nearest the point was dead. Distance to this dead tree, dbh, and species or genus where possible were recorded. Recalculation of the density data allowed an estimate of the numbers of dead trees/hectare, and their frequency and basal areas were calculated where possible.

Tree density in swamps was low, while shrub cover was high, so the vegetation there was sampled by a combination of long "belt" transects for trees and line intercepts for shrubs. A line was established through the center of the swamp, approximately parallel to the longest dimension. At approximately 50 meter intervals, the distance along a 25 m segment of line intercepted by each species of shrub or vine was recorded. The species and diameter of all trees within 5 m of the line on either side were recorded, giving a belt transect 10 × 25 m for trees. These sampling techniques provide estimates of percent cover and frequency of the shrubs, and by analyzing the gaps in cover along the lines, the total shrub cover of the stand. The tree measurements provide density, frequency and dominance (basal area/hectare) as well as average basal area. Along the south side of French Creek on the west side of the park (Fig. 1), the trees and saplings were tallied in a belt transect alone, 83 × 10 meters, to sample trees specifically along this creek.

We made other, non-quantitative, observations throughout the sampling, such as shrub species in the forests, condition of the soil surface, presence of exotic species, and evidence of grazing or insect pests. The reproduction in several gaps caused by the death of old trees was noted in different parts of the oak-dominated forest.

Extensive sampling of the flora was carried out from early spring until fall, in all types of habitats. Herbarium specimens were prepared of about 200 species.

There were 33 point-centered-quarter lines, totalling 267 points, with measurements on 1068 trees. Ten 25 m line intercepts and associated belt transects were measured.

Using tables of dominance, frequency, density, and importance values, the lines with the most similar tree composition were grouped into "forest types." In several cases the presence or absence of species, such as *Betula lenta*, contributed to a classification. Some differences between segments of lines were found on field checking to correspond to different site histories, and were thus classified as different forest types.

After all lines and points were assigned with confidence to a "type," the descriptive statistics were recalculated for the type as a whole. The forest types were then located on the base map. These types are used here for convenience in describing the different areas of the forest, and should not be taken to represent formal vegetation associations.

RESULTS

Twelve forest types were recognized based on forest canopy dominants. These fall into four categories: oak-dominated (Table 1); yellow poplar-dominated (Table 1); red maple-dominated (Table 1); and miscellaneous old-field successional types. Only those areas dominated by oak and red maple-arrowwood (*Viburnum dentatum*) appear not to have been cleared fields sometime in the last century. Charcoal hearths occur frequently in the oak-dominated forests, indicating that these were cut for charcoal in the past. Each type is described below and shown on the fold-out map. The lines between types fall generally along old roads and field edges. The apparently unlikely line along route 345, which was only built in the 1930's, does correspond with field edges in part, and in other areas with old stone walls and a small stream.

TABLE 1. Summary of forest type characteristics. 1a = mixed oak-sweet birch type; 1b = chestnut oak-scarlet oak-black oak type; 1c = white oak type; 2a = yellow poplar-oak type; 2b = yellow poplar-red maple type; 3a = high density red maple type; 3b = red maple-arrowwood type; 3c = red maple-sycamore type. – = none present, na = not available, + = less than 1.

	Cover type							
Species	1a	1b	1c	2a	2b	3a	3b	3c[a]
Acer rubrum								
IV tree[b]	11	15	17	9	26	90	53	49
tree basal area (cm^2)	212	150	151	341	395	269	889	480
tree density (#/ha)	79	89	134	45	178	698	176	275
tree frequency (%)	38	45	57	31	70	100	90	na
IV sapling[c]	10	26	20	12	28	42	na	5
Amelanchier canadense								
IV tree	+	1	3	–	–	3	–	–
tree basal area	98	36	121	na	na	37	na	na
tree density	+	6	21	–	–	15	–	–
tree frequency	1	3	14	–	–	7	–	–
IV sapling	3	1	26	4	2	10	na	–
Betula lenta								
IV tree	17	–	–	18	–	–	–	–
tree basal area	379	na	na	477	na	–	–	–
tree density	104	–	–	105	–	–	–	–
tree frequency	59	–	–	51	–	–	–	–
IV sapling	20	?2	–	15	4	–	na	2
B. alleghaniensis								
IV tree	–	1	7	–	–	–	–	–
tree basal area	na	540	143	na	na	–	–	–
tree density	–	6	48	–	–	–	–	–
tree frequency	–	4	29	–	–	–	–	–
IV sapling	–	?2	8	–	–	–	–	–
Carpinus caroliniana								
IV tree	1	1	1	1	–	–	–	–
tree basal area	55	49	32	78	na	–	–	–
tree density	5	11	11	7	–	–	–	–
tree frequency	1	4	7	5	–	–	–	–
IV sapling	2	2	–	11	3	–	–	–
Carya glabra								
IV tree	–	1	–	1	–	–	–	–
tree basal area	na	455	na	584	na	–	–	–
tree density	–	6	–	4	–	–	–	–
tree frequency	–	4	–	5	–	–	–	–
IV sapling	–	2	–	2	–	–	–	–
C. ovata								
IV tree	+	3	2	3	1	–	3	–
tree basal area	182	831	717	824	1217	–	472	–
tree density	5	11	11	11	6	–	12	–
tree frequency	7	7	7	10	3	–	10	–
IV sapling	+	+	–	1	1	–	na	–
C. tomentosa								
IV tree	–	3	–	1	–	–	–	–
tree basal area	na	218	na	140	na	–	–	–
tree density	–	22	–	4	–	–	–	–
tree frequency	–	12	–	5	–	–	–	–
IV sapling	–	2	–	1	–	–	–	–

TABLE 1. Continued

Species	Cover type							
	1a	1b	1c	2a	2b	3a	3b	3c[a]
Carya sp.								
IV tree	1	–	–	–	–	–	–	–
tree basal area	325	na	na	na	na	–	–	–
tree density	5	–	–	–	–	–	–	–
tree frequency	3	–	–	–	–	–	–	–
IV sapling	+	+	–	1	1	–	–	–
Castanea dentata								
IV tree	1	1	–	1	–	–	–	–
tree basal area	102	40	na	81	na	–	–	–
tree density	5	6	–	4	–	–	–	–
tree frequency	3	5	–	3	–	–	–	–
IV sapling	4	6	–	4	1	–	–	–
Celtis occidentalis								
IV tree	–	–	–	–	–	–	–	–
tree basal area	–	–	–	–	–	–	–	–
tree density	–	–	–	–	–	–	–	–
tree frequency	–	–	–	–	–	–	–	–
IV sapling	–	–	–	–	–	–	na	5
Cornus amomum								
IV tree	–	–	–	–	–	–	–	–
tree basal area	–	–	–	–	–	–	–	–
tree density	–	–	–	–	–	–	–	–
tree frequency	–	–	–	–	–	–	–	–
IV sapling	–	–	–	–	–	–	na	12
Cornus florida								
IV tree	1	–	–	–	1	–	–	–
tree basal area	52	na	na	na	103	–	–	–
tree density	5	–	–	–	6	–	–	–
tree frequency	3	–	–	–	3	–	–	–
IV sapling	12	18	9	14	13	3	na	2
Fagus americana								
IV tree	1	–	–	6	–	–	–	–
tree basal area	465	na	na	361	na	–	–	–
tree density	5	–	–	30	–	–	–	–
tree frequency	4	–	–	18	–	–	–	–
IV sapling	2	–	–	9	–	–	–	–
Fraxinus americana								
IV tree	+	+	–	2	4	–	7	15
tree basal area	55	27	na	412	661	na	196	318
tree density	+	+	–	11	19	–	20	95
tree frequency	1	1	–	10	12	–	40	na
IV sapling	2	2	–	9	14	3	na	15
Hamamelis virginiana								
IV tree	+	–	–	–	–	–	–	–
tree basal area	na	22	na	na	na	–	–	–
tree density	–	+	–	–	–	–	–	–
tree frequency	–	1	–	–	–	–	–	–
IV sapling	–	6	–	2	2	–	–	–
Juglans nigra								
IV tree	–	+	–	–	1	–	1	–
tree basal area	na	844	na	na	94	na	49	na
tree density	–	+	–	–	6	–	4	–

TABLE 1. Continued

Species	Cover type							
	1a	1b	1c	2a	2b	3a	3b	3c^a
tree frequency	–	1	–	–	3	–	40	na
IV sapling	–	–	–	–	2	–	na	–
Liriodendron tulipifera								
IV tree	10	2	8	31	48	–	–	–
tree basal area	1470	793	1020	1655	657	–	–	–
tree density	40	17	27	97	324	–	–	–
tree frequency	21	10	21	64	82	–	–	–
IV sapling	12	+	4	2	6	–	–	–
Morus sp.								
IV tree	–	–	–	–	–	–	–	–
tree basal area	–	–	–	–	–	–	–	–
tree density	–	–	–	–	–	–	–	–
tree frequency	–	–	–	–	–	–	–	na
IV sapling	–	–	–	–	–	–	na	2
Nyssa sylvatica								
IV tree	12	8	4	4	1	4	1	–
tree basal area	147	73	102	380	102	138	94	na
tree density	82	67	27	12	6	30	4	–
tree frequency	47	33	21	10	3	7	10	na
IV sapling	16	18	14	6	–	–	na	12
Ostrya virginiana								
IV tree	–	–	–	–	–	–	–	–
tree basal area	–	–	–	–	–	–	–	–
tree density	–	–	–	–	–	–	–	–
tree frequency	–	–	–	–	–	–	–	na
IV sapling	–	–	–	–	–	3	na	–
Pinus rigida								
IV tree	–	–	–	–	3	–	–	–
tree basal area	na	na	na	na	706	–	–	–
tree density	–	–	–	–	13	–	–	–
tree frequency	–	–	–	–	3	–	–	–
IV sapling	–	–	–	–	–	–	–	–
Platanus occidentalis								
IV tree	–	–	–	–	–	–	–	16
tree basal area	–	–	–	–	–	na	na	148
tree density	–	–	–	–	–	–	–	48
tree frequency	–	–	–	–	–	–	–	na
IV sapling	–	–	–	–	–	–	na	–
Populus grandidentata								
IV tree	–	3	–	–	–	–	–	2
tree basal area	–	558	–	–	–	–	–	148
tree density	–	17	–	–	–	–	–	11
tree frequency	–	8	–	–	–	–	–	na
IV sapling	–	–	–	–	–	–	na	–
Prunus serotina								
IV tree	–	–	3	–	4	–	4	2
tree basal area	na	na	1007	na	347	na	182	300
tree density	–	–	11	–	25	–	12	300
tree frequency	–	–	7	–	15	–	20	na
IV sapling	–	1	8	2	12	12	na	5
Pyrus malus								
IV tree	–	–	–	–	–	3	–	–

TABLE 1. Continued

Species	Cover type							
	1a	1b	1c	2a	2b	3a	3b	3c[a]
tree basal area	–	–	–	–	–	415	–	–
tree density	–	–	–	–	–	8	–	–
tree frequency	–	–	–	–	–	10	–	na
IV sapling	–	–	–	–	–	–	na	–
Quercus alba								
IV tree	13	2	30	5	1	–	–	1
tree basal area	1305	356	1270	1282	208	na	na	107
tree density	49	17	113	12	6	–	–	11
tree frequency	32	10	57	10	3	–	–	na
IV sapling	+	+	–	–	–	–	na	–
Q. coccinea								
IV tree	12	15	10	7	1	–	–	–
tree basal area	1708	769	608	1361	670	–	–	–
tree density	40	67	48	7	6	–	–	–
tree frequency	26	37	36	8	3	–	–	–
IV sapling	–	+	2	–	–	–	–	–
Q. palustris								
IV tree	–	–	–	–	–	3	5	–
tree basal area	–	–	–	–	–	69	1456	–
tree density	–	–	–	–	–	15	8	–
tree frequency	–	–	–	–	–	7	20	na
IV sapling	–	–	–	–	–	3	na	–
Q. prinus								
IV tree	5	19	4	1	–	–	–	–
tree basal area	945	531	248	1346	na	–	–	–
tree density	5	95	21	4	–	–	–	–
tree frequency	6	44	14	3	–	–	–	–
IV sapling	+	1	2	2	–	–	–	–
Q. rubra								
IV tree	+	–	–	2	–	–	–	–
tree basal area	1050	na	na	767	na	–	–	–
tree density	+	–	–	7	–	–	–	–
tree frequency	1	–	–	5	–	–	–	–
IV sapling	–	–	–	1	–	–	–	–
Q. velutina								
IV tree	10	17	6	6	4	–	–	–
tree basal area	1444	1072	767	1769	1656	–	–	–
tree density	35	61	27	12	13	–	–	–
tree frequency	26	33	14	10	6	–	–	–
IV sapling	–	–	2	–	–	–	–	–
Salix nigra								
IV tree	–	–	–	–	–	–	6	–
tree basal area	–	–	–	–	–	–	8064	–
tree density	–	–	–	–	–	–	4	–
tree frequency	–	–	–	–	–	–	10	na
IV sapling	–	–	–	–	–	–	na	–
Sassafras albidum								
IV tree	3	5	5	2	2	–	–	–
tree basal area	221	135	167	180	190	na	na	na
tree density	15	39	38	7	13	–	–	–
tree frequency	12	21	14	5	9	–	–	na
IV sapling	14	5	–	1	4	–	na	12

TABLE 1. Continued

	Cover type							
Species	1a	1b	1c	2a	2b	3a	3b	3c[a]
Ulmus rubra								
IV tree	–	–	–	–	1	–	16	–
tree basal area	na	na	na	na	211	na	164	na
tree density	–	–	–	–	13	–	48	–
tree frequency	–	–	–	–	3	–	?	na
IV sapling	–	–	–	–	9	18	na	12
Number of points	68	73	14	39	33	13	10[d]	1[e]
Tree stems/hectare	494	559	536	389	635	759	292	528
Saplings/hectare	654	434	413	368	174	278	na	482

[a] IV tree for this cover type = (rel. density + rel. dominance)/2 × 100; sapling data are relative frequency.
[b] IV tree = (rel. frequency + rel. dominance + rel. density)/3 × 100 (see text for more details).
[c] IV sapling = (rel. frequency + rel. dominance)/2 × 100.
[d] 10 transects, 25 × 10 m each.
[e] 1 transect, 83 × 10 m.

OAK-DOMINATED FOREST TYPES (Table 1). These stands were apparently cut for charcoal, but not cleared for agriculture. They are dominated by various species of *Quercus* spp. and correspond generally with the oak types described in 1939, by the Society of American Foresters (1954), and elsewhere in southeastern Pennsylvania (Keever 1973), but the relative proportions of the various species of oaks differ, as well as the associated species.

Mixed oak-sweet birch type. This type of forest dominates the northern half of the park on well-drained soils derived from Triassic conglomerates and shales (fold-out map). *Betula lenta* dominates this forest type in terms of density, but the trees are generally small, with only 9% of the trees more than 36 cm dbh. This is characterized as an oak type rather than birch because the next two most important species are both oaks (*Quercus alba* and *Q. coccinea*), and *Q. velutina* is also important. Although no one oak species has greater density than *Betula lenta,* each has greater basal area/hectare than *B. lenta*. Other important species in the forest are *Liriodendron tulipifera, Nyssa sylvatica,* and *Acer rubrum*.

In the sapling stratum, *Betula lenta, Nyssa sylvatica, Sassafras albidum,* and *Liriodendron tulipifera* dominate, associated with *Acer rubrum* and *Cornus florida*. Only 2 of the 167 saplings tallied were oaks. *Castanea dentata* sprouts were also present, in greater numbers than the oaks or any other minor associates. *Viburnum acerifolium* dominated the shrub layer in most places, with patchy distribution of ericaceous shrubs (especially *Vaccinium pallidum* and *Rhododendron periclymenoides*) and *Lindera benzoin*.

Variability within this vegetation type depends on local topography and land-use history. Extremely rocky areas, essentially rock fields, are dominated by *Betula lenta,* while moist sites near streams have a greater density of *Fagus grandifolia*. The transect near the developed historic area included 2 dead *Juniperus virginiana,* indicating that it was an agricultural field sometime in the past. It has significantly more dead trees than the rest of the transects in this forest type, 142/ha as compared with 41. Various species of oaks make up 65% of the dead trees elsewhere, but only 25% of the

N
RT 345
PARK ROAD
SPOUT CREEK
HOPEWELL ROAD
BAPTISM CREEK
FRENCH CREEK
BERKS COUNTY
CHESTER COUNTY
HARRISON-LLOYD ROAD
DEVELOPED AREA & FIELDS
MIXED OAK - BLACK BIRCH
CHESTNUT OAK - SCARLET OAK - BLACK OAK
WHITE OAK
TULIP POPLAR - OAK
TULIP POPLAR - RED MAPLE
HIGH DENSITY RED MAPLE
RED MAPLE - ARROWWOOD
RED MAPLE - SYCAMORE
RED CEDAR
ASH - TULIP POPLAR
ELM
BLACK WALNUT
800 Feet

dead trees along this line. Gaps left by dead trees throughout this forest type are being filled with dense stands of *Liriodendron tulipifera.*

Chestnut oak-scarlet oak-black oak type. This type of forest predominates in the southern third of the historic site, mainly on rugged terrain underlain by crystalline rocks (fold-out map). Oaks clearly dominate these forests, including *Quercus prinus, Q. coccinea,* and *Q. velutina. Betula lenta* is uncommon; none was encountered of the 268 trees tallied in the forest type. However, *Betula lutea* is present, and dominates locally in extremely rocky areas as does *B. lenta* in the northern part of the historic site. *Populus grandidentata* and *Kalmia latifolia* are also common in these forests. Other important associates are small individuals of *Acer rubrum, Nyssa sylvatica,* and *Carya* spp., especially *C. tomentosa.* The understory is generally dominated by ericaceous shrubs, especially *Vaccinium pericylmenoides,* with patches of *Lindera benzoin* and *Viburnum acerifolium.*

Acer rubrum and *Nyssa sylvatica* dominate the sapling layer, accompanied by *Cornus florida, Hamamelis virginiana, Castanea dentata,* and *Sassafras albidum. Quercus* saplings are rare. Along the southern edge of one field, the species invading at the edges is *Betula lenta,* which is uncommon in the older forest.

The stands of this type on gabbro and dolomite have very few dead trees. There were more than 150 dead trees/ha in the southernmost stand of this type of forest, however, mainly *Quercus* spp. and especially *Q. prinus.* A particularly high density of dead *Q. prinus* characterized a steep hilltop in the south. The trees, all about 14 cm dbh, were probably killed by gypsy moth damage. At two points on this hilltop there were no saplings within 25 m of the point, so the density estimate of 179/ha is an overestimate, being based on only those points which did have saplings within 25 meters of the point in all four quadrants.

White oak type. A ridge of dolomite east of Rte. 345 is forested with a white oak-dominated forest (fold-out map). This distinctive forest is quite open, with a low, mainly ericaceous shrub cover. In its lack of *Betula lenta* and the presence of *B. lutea* and some *Populus grandidentata* it is more like the chestnut-scarlet-black oak forest than the mixed oak-sweet birch type. Other important tree species are *Acer rubrum, Quercus coccinea, Q. velutina,* and *Liriodendron tulipifera.*

Amelanchier canadensis and *Acer rubrum* dominate the sapling layer, accompanied by *Nyssa sylvatica, Betula lutea, Prunus serotina,* and *Cornus florida.* Only a few oak saplings were found, none of which was white oak. In this forest type there are many multiple-trunked trees (23% of the total, as compared with less than 10% in any of the other forest types). This may suggest that this forest was severely damaged in the past.

YELLOW POPLAR-DOMINATED FOREST TYPES (Table 1). *Liriodendron tulipifera* comprises half or more of the basal area of trees in these stands, and occurs at well over half the sample points. It appears that all of the yellow poplar-dominated areas were previously cleared fields, judging by their similarity to those stands which we know from the 1937 aerial photograph were fields in 1937, the scattered occurrence of standing or down dead *Juniperus virginiana* in almost all stands, and the location of old roads, ruins and/or stone walls that may have been related to the fields.

Yellow poplar-oak type. This type of forest is most common in the northern parts of the park, near the headquarters and in the eastern headwaters of Baptism Creek (fold-out map). All of these areas were forested in 1937, so the woods are more than 50 years old.

Liriodendron tulipifera dominates these forests, more by its large size (average dbh 48 cm) than by its density (97 stems/ha, relative density = 0.26). In the northern sites (excluding the areas along Harrison-Lloyd Road) the major associate is *Betula lenta,* which in many of these sites has more stems/ha than *Liriodendron tulipifera,* but of considerably smaller size (average dbh 28 cm). As might be expected by the lack of *Betula lenta* in the nearby oak forests, the *Liriodendron* forest along the Harrison-Lloyd Road has little *B. lenta.* All of the sites have some *Quercus,* of various species, and generally large trees, although none that was sampled appeared to be field-grown. *Carya* spp. are also frequent associates, as well as *Acer rubrum* and *Nyssa sylvatica.* A patch of *Q. alba* along the Harrison-Lloyd Road is anomalous, and was also mentioned in the 1939 forest survey of the French Creek area (Stearns 1939).

Betula lenta is very common in the extremely rocky sites. For example, in one rocky area *Betula lenta* accounted for over half the stems tallied. On the other hand, along streams, as in the oak woods nearby, *Fagus grandifolia* is locally abundant. Along the line that followed Spout Creek there were slightly more *Fagus grandifolia* stems than *Liriodendron tulipifera,* although the average size was considerably smaller.

There is an average of about 30 dead trees/ha in the yellow poplar-oak stands; half of these are *Quercus* spp. and a fifth *Juniperus virginiana.*

As in the oak-dominated forests, *Betula lenta, Acer rubrum, Cornus florida,* and *Nyssa sylvatica* dominate the sapling layer. *Fagus grandifolia* saplings are locally abundant, especially along Spout Creek. *Liriodendron tulipifera, Quercus* spp. and *Carya* spp. saplings are rare (<2% of the saplings counted). The understory is similar to that in the oak forests, consisting of patches of ericaceous shrubs such as *Rhododendron periclymenoides* and *Vaccinium* spp., *Viburnum* spp., and *Lindera benzoin.*

Yellow poplar-red maple type. Liriodendron tulipifera clearly dominates these stands in all measures: frequency, density and basal area/ha (dominance). The areas northeast of Harrison-Lloyd Road were old fields just beginning to revert to forest in 1937, so, by extrapolation, it appears that areas near the visitor center were also old fields. Much of the area along the Harrison-Lloyd Road was still mapped as non-forest by the USGS in 1956 (Elverson quadrangle), so the woods may be only 30 years old. They were forested by 1966 (Berks County District 1966), so they are at least 20 years old.

The most abundant associate of *Liriodendron tulipifera* in these areas is *Acer rubrum,* with over one fourth of the stems (one-half are *L. tulipifera*). There are no other associates of any importance in terms of numbers or dominance. In the Harrison-Lloyd Road area, *Pinus rigida* is a rare but consistent component of this type of forest, as well as of the yellow poplar-oak forest across the road. There are also scattered *P. strobus* and *P. virginiana* in these woods. It seems possible that all of the pines were planted, a common practice in abandoned fields in the 1930's, but further detailed study would be necessary for verification.

Only 4 of the 132 trees tallied in these stands were *Quercus* spp. The two *Q. velutina* were large (>36 cm dbh), but the *Q. alba* and *Q. coccinea* were considerably smaller (16 and 29 cm respectively). By contrast, 17 of the 156 trees tallied in the yellow poplar-oak stands were *Quercus* spp. (11%) and most were >36 cm basal area. The *L. tulipifera* were also smaller on average in this type of forest, 29 cm dbh as compared with 47 cm, further suggesting that these are younger forests. With the exception of one *Carya ovata* and the two *Q. velutina,* no species in the yellow poplar-red maple stands had an average dbh greater than 36 cm, and most were considerably smaller. The average size of *Acer rubrum* in the yellow poplar-dominated forests was 22 cm dbh, over twice the size of *A. rubrum* in the oak-dominated forests.

No dead trees were found at points along lines where there were no pines. The average density of dead trees along the other lines was 100/ha, mainly pines (probably *P. rigida*) and *Prunus serotina*. As in the other yellow poplar-dominated woods, we found no dead yellow poplars.

Acer rubrum saplings dominate the sapling stratum, followed by *Fraxinus americana, Cornus florida, and Prunus serotina*. There was one *Carya* sapling (of 116 saplings) and no *Quercus* saplings along our lines. The density of saplings was very low, 174/ha. This value is an overestimate, because at 4 points there was no sapling within 25 meters of the point. In much of this area there was a thick shrub cover of *Lindera benzoin*.

RED MAPLE-DOMINATED FOREST TYPES (Tables 1 and 2). Although *Acer rubrum* is a common associate in all forested areas at Hopewell, it dominates the forests in wetter sites, forming almost pure stands in lowland forests less than 30 years old. Older stands are more diverse, in terms both of evenness and numbers of species, but are still dominated by red maple.

High density red maple type. These young forests have a high density of stems. Over ninety percent of the trees are *Acer rubrum*, with a few scattered *Amelanchier canadense, Nyssa sylvatica*, and *Quercus palustris*. The shrub cover of *Lindera benzoin* is thick, and there are few saplings, about a third as many per hectare as trees, but the diversity is higher. While *Acer rubrum* is most important in the sapling layer, *Ulmus, Prunus serotina*, and *Amelanchier canadense* also contribute significantly. No dead trees were encountered at any points in these stands.

Red maple-arrowwood type. Along Baptism Creek and French Creek south of Hopewell Road and east of Rte. 345, older red maple swamp forests predominate (foldout map). The density of stems is much lower than in any other forest type and the diversity is greater than in the young red maple stands. The maples are also much larger (34 cm dbh as compared with 18). *Viburnum dentatum* and *Lindera benzoin* dominate the very dense shrub cover that characterizes these wet areas (Table 2). These two species were found along almost all of the 10 line intercepts, each with >30% cover on the intercepts. The other shrub found along half the intercepts is *Ilex verticillata*, but its cover is low (9%). It was rare in 1936 (Stearns 1939). *Vitis* spp. abound in this open habitat, occurring along 6 of the 10 intercepts, with 10% cover. *Toxicodendron vernix* is a distinctive member of this community in some areas along with *Carex stricta* tussocks. *T. vernix* was rare in the area in 1936.

In the tree canopy, other important species are *Ulmus* (mainly *U. americana*) and *Fraxinus americana. Fraxinus nigra* occurs also in these woods, especially in the southeasternmost swamp, but was not present along any sampled intercept. Only 28 dead trees were found, with a mix of species and sizes.

Red maple-sycamore type. Along French Creek just west of Rte. 345 and again near the dam, the swamp forest canopy is more closed than in the swamps dominated by *Acer rubrum* and *Viburnum dentatum*, with 528 trees/ha. *Platanus occidentalis* forms a distinctive addition to the forest. Although there are relatively few *P. occidentalis* (only 9% of the stems) their large size gives them considerable importance in the canopy (23% of the basal area). These trees do not, however, appear to be reproducing, and the major proportion of the saplings are *Fraxinus americana, Ulmus* (prob-

TABLE 2. Shrub data for red maple-arrowwood forest. Importance value (relative frequency + relative % cover/2) × 100.

Species	% freq.	% cov	rel. fr.	rel. cov.	IV
Alnus serrulata	30	2	.06	.02	4
Cornus racemosa	30	2	.06	.02	4
Ilex verticillata	50	6	.10	.06	8
Lindera benzoin	100	32	.20	.33	26
Sambucus canadensis	20	+	.04	+	2
Toxicodendron vernix	20	2	.04	.02	3
Viburnum dentatum	90	33	.18	.34	26
V. prunifolium	20	2	.04	.02	3
Vitis spp.	60	10	.12	.10	11
Other*	70	8	.14	.08	11
gaps	100	27			

* other = species with less than 2% frequency. The species included in this category are *Viburnum lentago, Rubus phoenicolasius, R. allegheniensis, Celastrus scandens, Lonicera japonica, Clematis virginiana, Parthenocissus quinquefolia, Corylus americana, Toxicodendron radicans,* and *Ulmus americana.*

ably *U. americana*) and *Carpinus caroliniana*. The major shrubs are *Lindera benzoin, Ilex verticillata,* and *Viburnum prunifolium,* with many grapevines. The section of this forest that was sampled appears to be heavily grazed by deer, while the rest is in a pasture and grazed by domestic animals, which greatly decreases ground cover and reproduction.

OTHER SUCCESSIONAL STANDS. Several local areas with evidence of prior agricultural land-use do not fall into any of the categories above. Each of these has distinctive characteristics which are related to the local site characteristics.

Red cedar type. Juniperus virginiana is the dominant tree species in early post-agricultural succession in much of the Triassic piedmont of New Jersey and Pennsylvania. Abundant dead *J. virginiana* were found in the yellow poplar-oak stand near the headwaters of Baptism Creek, and scattered *J. virginiana* in other, younger yellow poplar-dominated stands. However, only four small stands of live *J. virginiana* were found, two of which were recently heavily disturbed.

One of the less disturbed stands is bounded on one side by a shallow ditch. It shows up clearly on the 1937 aerial photograph as a distinctive patch amid old fields reverting to red maple forest. The woods southeast of the ditch appear to have grown in a formerly drained field, with shallow ditches perpendicular to the one along the cedar field. A soil analysis done in 1971 reported very low calcium in this "cedar pasture" and lower pH there than in the other fields tested (Berks County District 1976).

It appears that deer have grazed this stand heavily, creating a "browse line" at about 1 meter. The most important associates of the *J. virginiana* are *Acer rubrum* and *Liriodendron tulipifera*. Saplings are also mainly *J. virginiana* and *Acer rubrum,* but there are also *Ulmus* saplings. We found no dead trees in this area. Shrubs are also distinctive, including *Clethra alnifolia* and large, productive, *Vaccinium corymbosum* bushes. The ground cover includes much grass, and *Pedicularis* sp., which we found to be abundant only here. *Clethra alnifolia* was rare in 1936 (Stearns 1939).

White ash-yellow poplar type. The abundance of *Fraxinus americana* distinguishes the tree stratum of this stand, but its most distinctive feature is the dense, choking growth of *Lonicera japonica, Celastrus orbiculatus,* and other weedy shrubs and vines. It was very difficult to penetrate because of the tangle of vines, including *Smilax rotundifolia;* shrubs, including *Viburnum* spp., *Lindera benzoin,* and *Rhus glabra;* and dead sapling-sized trees. There are many saplings (675/ha), but many are being killed by the vines, especially *Lonicera japonica.* Other trees, in addition to *F. americana* and *Liriodendron tulipifera,* are *Sassafras albidum, Juglans nigra,* and *Juniperus virginiana. Fraxinus americana* dominates the living sapling layer, with *Prunus serotina* and *Juniperus virginiana.*

Slippery elm type. Large (average dbh 42 cm) *Ulmus rubra* trees dominate one hillside, on an east slope of gabbro. Associated with them are *Acer rubrum* and *Liriodendron tulipifera. U. rubra* also dominates the sapling size class, accompanied by *Acer rubrum, Fraxinus americana,* and *Prunus serotina.* Many scattered dead *Juniperus virginiana* indicate that this stand was an agricultural field in the past. A few *Quercus palustris* trees indicate that the drainage is not as good as it superficially appears to be.

At the bottom of the slope we found the only *Tilia americana* and *Acer saccharum* that we encountered in the forests of Hopewell Furnace. There are no *Juniperus virginiana* in this part of this forest, so it seems that this low point is an older forest than that on the slope.

These elm woods had abundant *Orchis spectabilis* blooming in May, and a high diversity of spring flowers at the bottom of the slope.

Black walnut type. Juglans nigra trees were common in several disturbed areas near buildings, mixed with *Liriodendron tulipifera, Fraxinus americana, Quercus coccinea,* and *Q. alba.* It does not appear that the stands represent abandoned fields; rather, they seem to have invaded old lawns and the areas directly associated with the buildings. *Juglans nigra* responds favorably to nutrient-rich sites, so these may be areas enriched by the wastes of humans and animals, which would be most concentrated near habitations. It may also have spread from trees planted near houses for dye and nuts.

PAST AND PRESENT OLD FENCELINES. In the interior of several yellow poplar- or red maple-dominated woods there are distinctive rows of older trees, that are remnants of old fencelines. Trees found in these rows include *Sassafras albidum, Prunus serotina, Carya ovata, Quercus coccinea, Q. alba,* and *Fraxinus americana.* In wetter areas, the old tree lines also include *Nyssa sylvatica, Quercus bicolor* (one consisting of several fused trunks is 131 cm dbh), *Quercus palustris, Acer rubrum,* and *Carya ovata.*

The progenitors of these hidden fence lines are found in existing fence lines and in other long, narrow woodlots. For example, one well-developed fence line of trees and shrubs includes *Quercus coccinea, Q. alba, Juglans nigra,* and *Carya ovata* with a thick understory of shrubs and vines, such as *Viburnum prunifolium, Cornus florida, Rubus* spp., *Rosa multiflora,* and *Lonicera japonica.* A wider strip of trees found between the field along the Harrison-Lloyd Road and the road is a very mixed stand, with *Nyssa sylvatica, Juglans nigra, Ulmus* (probably *U. rubra*), *Liriodendron tulipifera, Fraxinus americana, Prunus serotina, P. avium, Sassafras albidum,* and *Celtis occidentalis. Vitis* spp. and *Celastrus orbiculatus* clamber up these trees. These two rows are typical of old, well-established fencelines. In contrast, a distinctly younger hedgerow formed on a boundary between two fields consists mainly of *Liriodendron tulipifera,* like the local early successional stands.

These types of woodlots all provide seed sources for abandoned fields, and have also probably acted as refuges for species which could not survive in the woods cut for charcoal or in the agricultural fields. Some species, such as *Celtis occidentalis,* seem to survive today mainly in such sites, and are rare in the interior of the forests.

FLORA. 573 species were identified at the Hopewell Furnace National Historic Site, about one-fifth of which are non-native. The non-native species are concentrated near the developed areas and the pasture, as well as near old house ruins and along roadsides. No endangered or threatened species were found. Voucher specimens were obtained for about 200 species, and are housed at the Academy of Natural Sciences of Philadelphia. A checklist of the flora follows the References Cited at the end of this paper.

DISCUSSION

In a small area, Hopewell Furnace National Historic Site encompasses a wide variety of habitats, from steep and rocky to wet lowlands. Superimposed on this diversity has been a variety of well-documented land-uses, related to the habitats as well as to convenience to water and transportation. The resulting vegetation is a microcosm of much more widespread patterns in the eastern oak forest region. Documentation of the forest vegetation is but a first step in answering questions about the dynamics of these forests, especially with relation to the effects of past land use.

OAK-DOMINATED FOREST STANDS. Bedrock is the most obvious cause of the different kinds of old-growth oak forests. The northern part of the park underlain by Triassic sandstones and conglomerate is characterized by the mixed oak-sweet birch forest, while the southern half of the park underlain by a variety of Paleozoic crystalline rocks is characterized by the chestnut oak-scarlet oak-black oak forest. The forest dominated by white oak is found on a ridge of dolomite. Slopes of a variety of steepness were sampled in all old-growth forests, so this factor is not apt to be a major one. Slope aspect may be of importance, though level and south-facing slopes were sampled in all three types of forest.

In the general region, bedrock differences are associated with different major forest types, e.g., oak-hickory on serpentine and diabase; oak-chestnut on Triassic sandstone and conglomerate, quartzite and diabase; and mixed mesophytic on limestone and mica-schist (Keever 1973). These differences in bedrock also caused differences in steepness of slope in her stands. In Chester County, Overlease (1987) found forests similar to Keever's oak-chestnut and oak-hickory on "xeric" sites, especially on quartzite, and "mesic" forests including more mesophytic taxa such as *Fagus grandifolia* on level areas, especially on schists. Keever found *Quercus prinus* to be the only tree species that occurred most commonly on quartzite and sandstone, along with *Vaccinium* spp., *Gaylussacia* spp., *Kalmia latifolia* and *Hamamelis virginiana*. This corresponds well with the chestnut oak-scarlet oak-black oak forest at Hopewell. It seems likely, then, that the bedrock differences are at least partially causing the variation in the old-growth upland forests.

Fire is another possible factor. Stearns (1939) noted that *Populus grandidentata* and *Kalmia latifolia* were fire indicators, and these are both characteristic of the forests of the southern part of the park. It is thus possible that these forests have burned more recently than the oak forests on Triassic bedrock. Other factors include the intensity of cutting in the past and the time since last cutting. The indirect influence of bedrock would affect all of these other factors.

SUCCESSIONAL RELATIONSHIPS. The high density of dead *Juniperus virginiana* in several areas of tulip poplar-oak forest indicate that these are old-field successional stands. On the other hand, the younger, tulip poplar-red maple stands include far fewer *J. virginiana,* indicating a change in successional pattern, from early dominance by *J.*

virginiana to early dominance by *Liriodendron tulipifera*. We found no dead *L. tulipifera* in the older successional stands, so it does not appear that the lower density of *L. tulipifera* here has resulted from thinning of a more dense stand. While the former importance of *J. virginiana* in abandoned fields may have been caused by grazing in these fields, the present intense grazing/browsing by white-tailed deer also should inhibit *L. tulipifera* regeneration (Brown 1960), and many recently abandoned fields in northern New Jersey which have not been grazed by domestic animals are dominated by *J. virginiana*. A more likely explanation for the difference in successional pattern is that there is a much greater seed source for *L. tulipifera* now than there was a century ago, so that the fast growing *L. tulipifera* trees are easily able to dominate the recently abandoned fields. In other words, the successional pattern is changed by the change in local land use and the local conditions at the time of abandonment.

In neither successional nor old-growth stands is there *Quercus* reproduction in the sapling size class, and it appears that the *Quercus* which are present in the successional stands are at least as old (or at least as large) as the *L. tulipifera*, so that they do not represent advance regeneration. This lack of *Quercus* reproduction is a common pattern in old-growth stands in the region (Buell et al. 1966; Davidson 1980; Lorimer 1984), although exceptions have been reported (Keever 1973; Russell 1979). It may be that *Quercus* spp. regenerate in a sporadic fashion, as indicated by the generally large size of all of the *Quercus* and by the abundance of seedlings of all species of *Quercus*. However, it also appears that *L. tulipifera* and *Acer rubrum* can be expected to be important components of the canopy of these forests in the future (Skeen et al. 1980; Lorimer 1984).

LOWLAND FORESTS. What is the future of the lowland forests? Will they become more diverse? There is evidence in even the youngest red maple swamps of the development of *Carex* tussocks, characteristic of the older swamp forests, and the older, undrained areas are similar to older swamp forests in the region (especially "Pine Swamp" in French Creek State Park). More time will be needed to interpret the patterns of change as the drainage ditches fill in and wetter conditions are reestablished in the formerly cultivated areas.

The vegetation map and descriptions provide a starting point for seeking answers to many questions of general interest. It appears that the vegetation is much more diverse than it was before European cultivation, with many unstable forest stands, the composition of which is difficult to relate to the natural environment. These are, however, the types of forests in which we test models of successional patterns, so knowledge of the historical factors affecting the vegetation should improve the fit between the models and field experiments.

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CHECKLIST OF HOPEWELL FURNACE VASCULAR PLANTS

The names used in this checklist are from Kartesz and Kartesz (1980). In exceptions where another name is used, the name from Kartesz and Kartesz follows in parentheses. Plants that have been introduced from other parts of the world are enclosed in brackets.

ACERACEAE: *Acer negundo, rubrum, saccharinum, saccharum.*

ADIANTACEAE: *Adiantum pedatum.*

ALISMATACEAE: *Alisma subcordatum* (*plantago-aquatica* var. *parviflorum*); *Sagittaria australis, latifolia.*

AMARANTHACEAE: *Amaranthus retroflexus.*

ANACARDIACEAE: *Rhus copallina, glabra, typhina; Toxicodendron radicans, vernix.*

ANNONACEAE: *Asimina triloba.*

APIACEAE: *Cicuta maculata; Cryptotaenia canadensis;* [*Daucus carota;*] *Hydrocotyle americana; Osmorhiza claytonii, longistylis; Sanicula canadensis, gregaria.*

APOCYNACEAE: *Apocynum androsaemifolium, cannabinum;* [*Vinca minor*].

AQUIFOLIACEAE: *Ilex verticillata.*

ARACEAE: *Acorus calamus* (*americanus*); *Arisaema triphyllum; Symplocarpus foetidus.*

ARALIACEAE: *Aralia nudicaulis; Panax quinquefolius, trifolius.*

ARISTOLOCHIACEAE: *Aristolochia serpentaria; Asarum canadense.*

ASCLEPIADACEAE: *Asclepias exaltata, quadrifolia, syriaca, tuberosa.*

ASPLENIACEAE: *Asplenium platyneuron; Athyrium filix-femina; Deparia acrostichoides; Dryopteris cristata, intermedia, marginalis, spinulosa; Onoclea sensibilis; Polystichum acrostichoides; Thelypteris hexagonoptera, novaboracensis, palustris; Woodsia obtusa.*

ASTERACEAE: [*Achillea millefolium;*] *Ambrosia artemisiifolia, trifida; Antennaria neglecta, neodioica* (*neglecta* var. *randii*), *plantaginifolia;* [*Arctium minus;*] *Aster cordifolius, divaricatus, lateriflorus, macrophyllus, pilosus, simplex, undulatus; Bidens bipinnata, connata, frondosa;* [*Carduus nutans;*] [*Cichorium intybus;*] *Cirsium* [*arvense,*] *discolor* [*vulgare*]; *Conyza canadensis; Erechtites hieracifolia; Erigeron annuus, philadelphicus, pulchellus, strigosus; Eupatorium fistulosum, perfoliatum, rugosum, sessilifolium;* [*Galinsoga ciliata;*] *Euthamia graminifolia; Gnaphalium obtusifolium; Hieracium* [*caespitosum, flagellare,*] *scabum, venosum; Krigia biflora; Lactuca biennis, canadensis;* [*Leucanthemum vulgare;*] *Mikania scandens; Prenanthes altissima; Rudbeckia hirta, laciniata; Senecio aureus; Solidago altissima* (*canadensis* var. *scabra*), *bicolor, caesia, canadensis, juncea, nemoralis, rugosa;* [*Taraxacum officinale;*] [*Tussilago farfara;*] *Vernonia novaboracensis.*

BALSAMINACEAE: *Impatiens capensis.*

BERBERIDACEAE: [*Berberis thunbergii;*] *Podophyllum peltatum.*

BETULACEAE: *Alnus rugosa* (*incana* ssp. *rugosa*), *serrulata; Betula alleghaniensis, lenta, nigra; Carpinus caroliniana; Corylus americana; Ostrya virginiana.*

BIGNONIACEAE: [*Campsis radicans*].

BORAGINACEAE: *Cynoglossum virginianum;* [*Echium vulgare;*] *Hackelia virginiana; Myosotis laxa* [*scorpioides*]; [*Symphytum officinale*].

BRASSICACEAE: [*Alliaria petiolata;*] *Arabis canadensis;* [*Barbarea vulgaris;*] *Cardamine bulbosa, pensylvanica; Dentaria laciniata;* [*Lepidium campestre;*] [*Nasturtium microphyllum;*] [*Rorippa sylvestris;*] [*Sisymbrium officinale;*] [*Thlaspi arvense*].

CALLITRICHACEAE: *Callitriche heterophylla.*

CAMPANULACEAE: *Campanula aparanoides; Lobelia cardinalis, inflata, spicata; Triodanis perfoliata.*

CANNABINACEAE: [*Humulus japonicus*].

CAPRIFOLIACEAE: [*Lonicera japonica, morrowi;*] *Sambucus canadensis;* [*Symphoricarpos orbiculatus;*] *Viburnum acerifolium, dentatum, lentago, prunifolium, recognitum.*

CARYOPHYLLACEAE: *Cerastium arvense, nutans;* [*Dianthus armeria;*] *Paronychia canadensis;* [*Saponaria officinalis;*] [*Silene alba, vulgaris;*] *Stellaria alsine, longifolia,* [*media,*] *pubera.*

CELASTRACEAE: *Celastrus* [*orbiculatus,*] *scandens; Euonymus* [*alatus,*] *americanus* [*fortunei*].

CERATOPHYLLACEAE: *Ceratophyllum demersum.*

CHENOPODIACEAE: [*Chenopodium album;*] *Chenopodium ambrosioides.*

CLETHRACEAE: *Clethra alnifolia.*

CLUSIACEAE: *Hypericum mutilum,* [*perforatum,*] *punctatum.*

COMMELINACEAE: [*Commelina communis*].

CONVOLVULACEAE: *Calystegia sepium.*

CORNACEAE: *Cornus alternifolia, amomum, florida, foemina.*

CRASSULACEAE: [*Sedum telephium*].

CYPERACEAE: *Carex albolutescens, amphibola, annectens, artitecta, atlantica, blanda, bromoides, cephalophora, communis, convoluta, crinita, gracilescens, gracillima, granularis, gynandra, hirsutella, intumescens, laxiculmis, laxiflora, lupulina, lurida, normalis, pensylvanica, prasina, rosea, scoparia, stipata, stricta, swanii, vulpinoidea; Cyperus bipartitus* (*rivularis*), *filiculmis, strigosus; Dulichium arundinaceum;*

Eleocharis acicularis, erythropoda, obtusa, tenuis; Rhynchospora capitellata; Scirpus atrovirens, cyperinus, expansus, georgianus, hattorianus, polyphyllus, tabernaemontanii.

Dennstaedtiaceae: *Dennstaedtia punctilobula; Pteridium aquilinum.*

Dioscoreaceae: *Dioscorea villosa.*

Eleagnaceae: [*Eleagnus umbellata*].

Equisetaceae: *Equisetum arvense, sylvaticum.*

Ericaceae: *Chimaphila maculata; Gaylussacia baccata; Kalmia latifolia; Lyonia ligustrina; Monotropa uniflora; Pyrola americana, elliptica; Rhododendron pericylmenoides; Vaccinium corymbosum, pallidum, stamineum.*

Euphorbiaceae: *Acalypha rhomboidea, virginica; Chamaesyce maculata, nutans.*

Fabaceae: *Amphicarpa bracteata; Apios americana; Cassia nictitans; Cercis canadensis;* [*Coronilla varia;*] *Crotolaria sagittalis; Desmodium canescens, nudiflorum, paniculatum, perplexum, rotundifolium;* [*Kummerowia striata;*] *Lespedeza* [*cuneata,*] *intermedia, repens;* [*Lotus corniculatus;*] [*Medicago lupulina;*] [*Melilotus alba, officinalis;*] *Robinia pseudoacacia;* [*Trifolium aureum, pratense, repens*].

Fagaceae: *Castanea dentata; Fagus grandifolia; Quercus alba, bicolor, coccinea, prinus* (*montana*), *palustris, rubra, velutina.*

Gentianaceae: *Gentiana andrewsii; Gentianopsis crinita.*

Geraniaceae: *Geranium maculatum.*

Hamamelidaceae: *Hamamelis virginiana.*

Hydrocharitaceae: *Elodea nuttallii.*

Hydrophyllaceae: *Hydrophyllum virginianum.*

Iridaceae: *Sisyrinchium angustifolium, mucronatum.*

Juglandaceae: *Carya glabra, ovalis, ovata, tomentosa; Juglans nigra.*

Juncaceae: *Juncus effusus, marginatus, platyphyllus, subcaudatus, tenuis; Luzula multiflora.*

Lamiaceae: *Clinopodium vulgare; Collinsonia canadensis; Cunila origanoides;* [*Glecoma hederacea*] [*Lamium amplexicaule, purpureum;*] [*Leonurus marrubiastrum;*] *Lycopus americanus, uniflorus, virginicus; Mentha arvensis* [*piperata*]; *Monarda clinopodia;* [*Nepeta cataria;*] [*Perilla frutescens;*] *Prunella vulgaris; Pycnanthemum incanum, tenuifolium, virginianum; Salvia lyrata; Scutellaria elliptica, integrifolia, lateriflora; Trichostema dichotomum.*

Lauraceae: *Lindera benzoin; Sassafras albidum.*

Lemnaceae: *Lemna minor.*

Liliaceae: *Allium canadense* [*vineale*]; [*Asparagus officinalis;*] *Lilium canadense; Erythronium americanum;* [*Hemerocallis fulva;*] *Hypoxis hirsuta; Maianthemum canadense; Medeola virginiana;* [*Ornithogalum umbellatum;*] *Polygonatum biflorum, pubescens; Smilacina racemosa; Uvularia perfoliata, sessilifolia; Veratrum viride.*

Linaceae: *Linum* sp.

Lycopodiaceae: *Lycopodium digitatum, obscurum.*

Lythraceae: *Cuphea viscosissima.*

Magnoliaceae: *Liriodendron tulipifera.*

Malvaceae: [*Hibiscus trionum*].

Menispermaceae: *Menispermum canadense.*

Moraceae: [*Broussonetia papyrifera;*] [*Morus alba*].

Nymphaeaceae: *Nuphar lutea.*

Nyssaceae: *Nyssa sylvatica.*

Oleaceae: *Fraxinus americana, nigra* [*Ligustrum vulgare*].

Onagraceae: *Circaea lutetiana; Gaura biennis; Ludwigia alternifolia, palustris; Oenothera biennis, fruticosa.*

Ophioglossaceae: *Botrychium dissectum, oneidense, virginianum; Ophioglossum vulgatum.*

Orchidaceae: *Corallorhiza odontorhiza; Cypripedium acaule; Galearis spectabilis; Goodyera pubescens; Isotria verticillata; Liparis lilifolia; Platanthera lacera; Spiranthes cernua, lacera.*

Orobanchaceae: *Epifagus virginiana; Orobanche uniflora.*

Osmundaceae: *Osmunda cinnamomea, claytoniana, regalis.*

Oxalidaceae: *Oxalis europaea, stricta.*

Papaveraceae: *Sanguinaria canadensis.*

Phytolaccaceae: *Phytolacca americana.*

Pinaceae: *Juniperus virginiana; Pinus rigida, strobus, virginiana; Tsuga canadensis.*

Plantaginaceae: *Plantago aristata,* [*lanceolata, major,*] *rugelii.*

Platanaceae: *Platanus occidentalis.*

Poaceae: *Agrostis hiemalis, perennans, stolonifera; Andropogon virginicus;* [*Anthoxanthum odoratum;*] *Arrhenatherum elatius; Brachyelytrum erectum;* [*Bromus inermis;*] *Cinna arundinacea;* [*Dactylis glomerata;*] *Danthonia compressa, spicata;* [*Digitaria ischaemum, sanguinalis;*] [*Echinochloa crusgalli;*] [*Eleusine indica;*] *Elymus villosus; Eragrostis spectabilis; Festuca* [*elatior,*] *obtusa* [*rubra*]; *Glyceria melicaria, septentrionalis, striata;* [*Holcus lanatus;*] *Hystrix patula; Leersia oryzoides, virginica;* [*Lolium multiflorum;*] [*Microstegium vimineum;*] *Muhlenbergia schreberi, sobolifera; Panicum anceps, boscii* (*Dichanthelium b.*), *clandestinum* (*Dichanthelium c.*), *dichotomiflorum, dichotomum* (*Dichanthelium d.*), *lanuginosum* (*Dichanthelium acuminatum*), *latifolium* (*Dichanthelium l.*); *Paspalum laeve;* [*Phleum pratense;*] *Poa* [*compressa,*] *pratensis, trivialis; Schizachyrium scoparium; Setaria* [*faberi,*] *geniculata* [*glauca, viridis*]; *Sorghastrum nutans; Sphenopholis obtusata; Tridens flavus.*

Polygonaceae: *Polygonum arifolium,* [*aviculare, caespitosum,*] *pensylvanicum,* [*persicaria,*] *punctatum, sagittatum, scandens, virginianum* [*Rumex acetosella, crispus, obtusifolius*].

Polypodiaceae: *Polypodium virginianum.*

Portulacaceae: *Claytonia virginica.*

Potamogetonaceae: *Potamogeton* [*crispus,*] *epihydrus, foliosus.*

Primulaceae: *Anagallis arvensis; Lysimachia ciliata, quadrifolia.*

Ranunculaceae: *Anemone virginiana; Caltha palustris; Cimicifuga racemosa; Clematis virginiana; Hepatica americana* (*nobilis* var. *obtusa*); *Ranunculus abortivus,* [*bulbosus,*] *hispidus, pensylvanicus, recurvatus; Thalictrum pubescens, thalictroides.*

Rosaceae: *Agrimonia gryposepala, parviflora, pubescens; Amelanchier canadense; Crataegus crus-galli, holmesiana; Fragaria virginiana; Geum canadense;* [*Malus pumila;*] *Potentilla canadensis,* [*intermedia,*] *norvegica,* [*recta,*] *simplex; Prunus* [*avium,*] *serotina, virginiana; Rosa carolina,* [*multiflora,*] *palustris; Rubus allegheniensis, enslenii, hispidus, occidentalis* [*phoenicolasius*].

Rubiaceae: *Cephalanthus occidentalis; Galium aparine, circaezans, lanceolatum,* [*mollugo,*] *obtusum, pilosum, triflorum; Hedyotis caerulea; Mitchella repens.*

Salicaceae: *Populus grandidentata; Salix nigra.*

Saxifragaceae: *Chrysosplenium americanum; Heuchera americana; Mitella diphylla; Penthorum sedoides; Saxifraga pensylvanica.*

Scrophulariaceae: [*Chaenorrhinum minus;*] *Chelone glabra; Gratiola neglecta;* [*Linaria vulgaris;*] *Melampyrum lineare; Mimulus alatus, ringens; Pedicularis canadensis, lanceolata;* [*Penstemon digitalis;*] *Scrophularia lanceolata;* [*Verbascum blattaria, thapsus;*] *Veronica americana,* [*arvensis, officinalis,*] *peregrina.*

Simaroubaceae: [*Ailanthus altissima*].

Smilacaceae: *Smilax glauca, herbacea, rotundifolia, tamnoides.*

Solanaceae: *Physalis subglabrata; Solanum carolinense.*

Sparganiaceae: *Sparganium americanum.*

Tiliaceae: *Tilia americana.*

Ulmaceae: *Celtis occidentalis; Ulmus americana, rubra.*

Urticaceae: *Boehmeria cylindrica; Laportea canadensis; Pilea pumila.*

Verbenaceae: *Phryma leptostachya; Verbena hastata, urticifolia.*

Violaceae: *Viola affinis, cucullata* (*obliqua*), *hirsutula, macloskeyi, pubescens, rostrata, sagittata, sororia, triloba.*

Vitaceae: *Parthenocissus quinquefolia; Vitis aestivalis, labrusca, riparia, vulpina.*

Bartonia No. 54: 144–145, 1988

REVIEWS

The Brightest Jewel; A History of the National Botanic Gardens, Glasnevin, Dublin, by E. Charles Nelson and Eileen M. McCracken. Boethius Press, Kilkenny, Ireland. 1987. 275 pp.

In 1972, for the Morton Arboretum's Golden Jubilee, Ian MacPhail organized a retrospective exhibition at the Newberry Library which dealt with the influence of botanical gardens on the history of the book. In his introductory essay to the exhibition catalog, *Hortus Botanicus,* Joseph Ewan observed that, while many books have grown from botanical garden collections, relatively few have focused on the rich social history of the gardens themselves. Most of the notable exceptions have come from abroad, including Wilfrid Blunt's 1978 classic *In For A Penny* (a history of the Royal Botanical Gardens, Kew) and Fletcher and Brown's authoritative history *The Royal Botanic Garden, Edinburgh, 1670–1970* (1970).

Now, thanks to the seamless collaboration of Dr. Eileen McCracken and Dr. E. Charles Nelson, another book has joined this select bibliography. It is aptly named *The Brightest Jewel,* its title drawn from an 1819 quotation describing Glasnevin Gardens, Dublin.

The colorful history of Ireland's National Botanic Gardens (established by a seed grant from the Irish Parliament to the Dublin Society in 1790) is the primary focus of the book, but it is much more than a local history. Its opening chapters offer an insightful review of early botanical gardens in Europe and the British Isles. Another chapter deals with far-flung botanical exploration and plant collecting, including brief summaries of the North American travels of John Lyon, John Bradbury (see Nelson and Parnell's article in this issue of *Bartonia*), Thomas Coulter, and Thomas Drummond, whose North American specimens were subsequently propagated at Glasnevin. There is even an essay on the botanical influences on medicine in Ireland in one of the book's three appendices.

With the relevant groundwork laid, the authors take us on a fascinating trip through the political and scientific growth of Glasnevin, carefully relating each major development to activities in other botanical gardens and the world at large. This is, in short, an extremely thorough history of botanical activity in Ireland in its broadest context, as well as an eminently readable account of one of the world's great public gardens. Even readers who have not seen Glasnevin or are not planning a trip to Dublin will find topics of interest here. Carefully researched, engagingly written, copiously illustrated and well designed, *The Brightest Jewel* is a model on which other institutional histories might well be based. ROBERT M. PECK

A Flora of the Vascular Plants of Cattaraugus County, New York, by Stephen W. Eaton and Edith Feuerstein Schrot. Bulletin of the Buffalo Society of Natural Sciences, Vol. 31. 1987. iv + 235 pp.

Having resided in Cattaraugus County in southwestern New York for the first 27 years of my life, I was very pleased to receive this book in the mail late last year. I enjoyed learning about the discoveries (e.g., *Carex chordorrhiza* and *Eleocharis intermedia*) the authors made in glacial wetlands in the northeastern part of the county. Although there are extensive wetlands in the county, some common species such as *Pontederia cordata* and *Peltandra virginica* are yet unknown. Switching to upland, how come *Betula papyrifera* is absent? I always thought it should grow there but never saw it. The authors report neither *B. papyrifera* or *B. populifolia* in the county.

The format of the book is excellent. They break the Engler tradition and follow Cronquist for flowering plant families. There are sections discussing climate, geology, history, and habitats—much like Zenkert's *The Flora of the Niagara Frontier Region* (reviewed in Bartonia No. 17). I wish the habitat descriptions were more thorough and said more about the plants at particular sites. There are no keys or descriptions and therefore other floras are needed to identify plants. The field botanist is rewarded by an excellent map showing collecting localities as well as much locality data, usually in the form of brief specimen citations, included with information given for each species.

The work of former club member, Robert Gordon, is used for describing the forest types in the county (portrayed on a fold-out map). Most of the forest north of the glacial boundary is Beech-Birch-Maple-Hemlock Forest and south of it is Oak Forest. The glacial boundary follows the course of the Allegheny River fairly closely through the southern part of the county.

The authors are to be congratulated for their careful comprehensive treatment of the vascular plants of Cattaraugus County. Now we can look for the plants that must be there that they didn't find. ALFRED E. SCHUYLER

Bartonia No. 54: 146–150, 1988

NEWS AND NOTES

A TIDAL SWAMP FOREST IN NEW JERSEY. 1987 fieldwork by the New Jersey Natural Heritage Program has identified a rare natural community from Salem County. On October 1, A. E. Schuyler, D. B. Snyder, and I explored a tidal swamp forest along the Deep Run tributary of Alloway Creek. The swamp had a rather open canopy of *Fraxinus pennsylvanica* with *Acer rubrum* also present in the canopy. The trees were more than 8 m in height and had a DBH greater than 20 cm. They appeared healthy and predominantly occurred on hummocks that were approximately 1 m in height. The Shrub layer was quite diverse including *Ilex verticillata, Viburnum dentatum, Rhododendron viscosum, Clethra alnifolia, Alnus* sp., *Rosa palustris, Cephalanthus occidentalis, Aronia* sp., and *Vaccinium corymbosum. Peltandra virginica, Pontederia cordata,* and *Nuphar lutea* were frequent in the herb layer. Other herbs found on either mud substrate or hummocks included *Polygonum sagittatum, Thelypteris palustris, Osmunda regalis, Carex stricta, Impatiens capensis, Zizania aquatica, Aster puni ceus,* and *Polygonum punctatum.* Although the entire swamp was not explored, it was apparent that at least five to ten acres was receiving regular tidal inundation. The swamp has been classified on U.S. Fish and Wildlife Service National Wetlands Inventory maps as a deciduous shrub scrub palustrine wetland (map code PSS1) with no indication of tidal status. Further examination of these maps for the rest of southern New Jersey south of Asbury Park (excluding quadrangles for Green Bank, Cape May, and Wildwood) found only 9 occurrences of tidally influenced shrub scrub palustrine wetlands (map codes PSS1R, PSS1/EMR, PSS1N/EMR) with less than 450 acres total. Tiner (1985) does not discuss palustrine tidal swamp forests in his description of wetlands of New Jersey. McVaugh (1945) has described a tidal swamp forest from the Hudson River which includes *Fraxinus pennsylvanica* and *Acer rubrum* in the canopy layer. Similar communities may exist in Maryland (D. Boone pers. comm. 1987).

The Natural Heritage Program defines a natural community to be: a distinct and reoccurring assemblage of populations of plants, animals, bacteria, and fungi naturally associated with each other and their physical environment. The tidal forest at Deep Run is a distinct and viable natural community which appears to be present in other river systems of the Northeast. The available data indicates that this is a rare wetland community in New Jersey. The Natural Heritage Program is interested in learning of any occurrences of this community in New Jersey. Please contact T. Breden, Office of Natural Lands Management, CN 404, 501 East State Street, Trenton, NJ 08625.

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THOMAS F. BREDEN

RARE PLANT SURVEY UPDATE. The Eastern Pennsylvania Rare Plant Survey continued in 1987 under a grant from the Wild Resources Conservation Fund to the Morris Arboretum of the University of Pennsylvania. Dr. Ann F. Rhoads, Director of Botany at the Morris Arboretum, the principal investigator, was assisted in the field by Ann Newbold, Richard Mellon, and Jack Holt.

Survey results during 1987 included several apparent new state and county records. The discovery of a well established population of *Cyperus serotinus* Rottb. in the intertidal zone along the Delaware River in Bucks County represents the first time this species has been found in Pennsylvania. This is the second collection of this European species from the Delaware estuary, as Fogg collected it in Salem County, New Jersey, in 1935.

Two other intertidal species which are apparently fairly recent arrivals along the Delaware River are *Eleocharis parvula* (R&S) Link and *Sagittaria calycina* Engelm. var. *spongiosa* Engelm.

Eleocharis parvula, first noted in 1984 as several small stands on both sides of the Neshaminy Creek near its mouth (Rhoads 1985), appears to be spreading. Recent observations indicate that the population now extends for several hundred feet along the upper limit of the intertidal zone on the east side of the Neshaminy.

Sagittaria calycina var. *spongiosa,* first discovered by Ferren in 1972 (Ferren and Schuyler 1980) at a single site in Bristol, has now been found at three additional locations along the Delaware River in Bucks County. Fernald describes its range as New Brunswick to Virginia on tidal mud of brackish estuaries (Fernald 1950). It is clearly expanding within the Delaware Estuary.

The discovery of a large colonial shrub of *Cornus drummondii* Meyer at the Tinicum Wildlife Refuge in Philadelphia County is also a first for the state. Whether this plant can be considered a ''native'' is questionable due to the disturbed nature of the site. *C. drummondii* occurs from Mississippi and Texas north through the midwest to southern Ontario according to Fernald (Fernald 1950). Jim Bissell (pers. comm.) reports that the species is common in abandoned pastures, old fields, and floodplains in northwestern Ohio but absent in the northeastern part of the state.

Field work in Tioga County in northcentral Pennsylvania resulted in the discovery of populations of *Carex oligosperma* Michx. in three separate high altitude bogs. *C. oligosperma* had not previously been reported from Tioga County (Wherry et al. 1979).

Scleria muhlenbergii Steud. (syn. *S. reticularis* Michx. var. *pubescens* Britt.), a species which had been listed as extirpated in Pennsylvania (DER 1987), was discovered growing in a boggy pasture on the Berks/Chester county line. While there is an earlier record of this species from Nottingham in Chester County it has not previously been collected in Berks County.

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ANN F. RHOADS

EASTERN PENNSYLVANIA NATURAL DIVERSITY INVENTORY 1987 VEGETATION SURVEY HIGHLIGHTS. The Pennsylvania Natural Diversity Inventory (PNDI) is a comprehensive computer-assisted ecological inventory designed by The Nature Conservancy, the Department of Environmental Resources-Bureau of Forestry, and the

Western Pennsylvania Conservancy, with cooperation from the Morris Arboretum of the University of Pennsylvania. The Inventory is a systematic and ongoing survey to collect and store, in a centralized data management system, information about the status and distribution of rare and endangered species, distinct biotic communities, and significant geological features in Pennsylvania. The PNDI staff has collected and processed information on over 6500 element occurrences (sites). At the close of the 1987 field survey season the PNDI, through its contractors, collaborators, and staff, had documented an estimated 1400 occurrences of Pennsylvania's rare flora and fauna. Several of the more significant plant finds made in 1987 by the eastern office of the Inventory are listed below. The state by state status information was obtained from The Nature Conservancy's International Databases, Arlington, Virginia, and then checked with the individual natural heritage program.

Two new populations of *Poa paludigena* were found this year, one each in Berks and Carbon counties. At both sites it was found along small spring fed streams growing with *Chrysosplenium americanum, Cardamine pennsylvanica,* and *Senecio aureus. Poa paludigena* is found in spring fed swamps and on talus slopes in Minnesota (1 site), Michigan (1 site), New York (1 site), Indiana (12+ sites), Virginia (1 site), and Pennsylvania (7 sites). It is reported historic or extirpated in Wisconsin, Illinois, and Ohio. It is currently listed as endangered in Pennsylvania.

Carex polymorpha was found at one new site in Carbon County. Vegetative reproduction appears good in a *Quercus alba–Acer rubrum/Osmunda cinnamomea* moist acid forest, and mature fruits with viable achenes were found along jeep road edges. *Carex polymorpha* has been found at three sites in previous years, where it has been growing in disturbed and open areas associated with pitch pine-scrub oak barrens. Thousands of additional plants were found in 1987 growing in a *Rhododendron canadense/Kalmia angustifolia/Sphagnum* sp. seepage community at one of these previously known localities. *Carex polymorpha* is currently listed as endangered in Pennsylvania and is being considered for federal listing. It is extant in Maine, New Jersey, Pennsylvania, Virginia, and West Virginia, each of these states with five or fewer sites. Delaware, Massachusetts, Maryland, New Hampshire, New York, and Rhode Island report this species as either historic or extirpated.

Eleocharis compressa, was collected while conducting vegetation surveys with Thomas Rawinski of The Nature Conservancy's Eastern Regional Heritage Task Force in June on the Susquehanna River, Lancaster County. It is abundant in rock crevices in a shallow water portion of the river. Common associated species include *Eleocharis erythropoda, Justicia americana, Scirpus pungens,* and *Spartina pectinata.* This species has not been recorded from the Susquehanna River since 1899. It is currently extant at one other Pennsylvania site in Erie County. *Cyperus difformis,* first reported for Pennsylvania by Smith in 1986 (see Bartonia No. 52), was found in great abundance at more than 10 sites on the lower Susquehanna River. It frequently dominated shallow water sandy strand communities, and was growing with two state rare species, *Ammannia coccinea* and *Rotala ramosior. C. difformis* may well be on the increase in this habitat, but further observations are needed. Another discovery made this year from the lower Susquehanna River was *Ludwigia decurrens* by J. Walck and T. Smith.

Tomanthera auriculata, a species of wet prairies and a variety of open upland habitats, is currently known from Ohio (fewer than 10 sites), Tennessee (1 site), Mississippi (1 site), Missouri (fewer than 5 sites), Illinois (12 sites), Kansas (1 site), and after the 1987 field season, Pennsylvania (1 site). In August approximately 50 individuals of this

Pennsylvania endangered species were discovered near a Lehigh County abandoned zinc mine.

A new location was found for the state endangered species *Onosmodium hispidissimum* in Juniata County. This species is currently known from only one other site in Pennsylvania (Huntingdon County), and has not previously been reported from Juniata County. Approximately 45 individuals were found growing on the edge of a southwest facing xeric limestone glade. The glade is dominated by the state rare grass *Bouteloua curtipendula*.

Scirpus acutus was found in a *Toxicodendron vernix* calcareous seepage wetland which contains small openings dominated by *Eleocharis erythropoda*. Approximately 200 culms of the Pennsylvania endangered *S. acutus* were found growing on the edge of the *E. erythropoda* openings in partial shade of the taller shrubs. This Snyder County population is the second known site for *Scirpus acutus* in the Commonwealth, with the next two closest populations being in Erie County, PA and Warren County, NJ.

A second site was found for the state endangered black-stemmed spleenwort *Asplenium resiliens*. Both of the two extant Pennsylvania populations are located in Franklin County. This most recently discovered population is from a moist limestone cliff and is growing with *A. platyneuron, A. Trichomanes, Camptosorus rhizophyllus,* and *Pellaea glabella*.

Listera smallii was found in Adams County this July. The very small population was located in an acid seep; associate species include *Clintonia borealis, Cornus canadensis, Dalibarba repens,* and *Trientalis borealis*. This is the fourth site the PNDI has located for this wooodland orchid, which is currently listed as endangered in Pennsylvania.

One population of *Juncus militaris* was located in the shallow waters of an undisturbed glacial lake in Pike County. This state endangered species, known from only two additional sites in Pennsylvania, was found growing with the state rare species *Nymphoides cordata* and *Utricularia purpurea*.

Three sites were located in Pennsylvania this year for the state endangered *Arabis missouriensis*. Inventory staff located a small Columbia County population growing on the edge of a calcareous shale road cut through a *Pinus strobus* plantation. Two Montgomery County sites were confirmed by botanists from the Morris Arboretum of the University of Pennsylvania. These three sites are the only known extant populations for this species in the Commonwealth.

Ranunculus longirostris was found this year in the Conodoguinet Creek in Cumberland County. This is the second population known for this species in Pennsylvania, the first being reported from Erie County. This aquatic crow-foot was found growing in swift waters, up to one foot in depth, with *Myriophyllum spicatum, Elodea canadensis, Heteranthera dubia, Potamogeton nodosus, P. crispus,* and *P. pectinatus*.

The Pennsylvania Natural Diversity Inventory is funded by The Nature Conservancy, the Western Pennsylvania Conservancy, and the Wild Resource Conservation Fund. We invite the participation and correspondence of those interested in the Inventory. If interested, contact Pennsylvania Natural Diversity Inventory, 34 Airport Drive, Middletown, PA 17057. KATHLEEN D. REGAN AND THOMAS L. SMITH

LARGE *PLATANUS OCCIDENTALIS*. Among the big trees in Pennsylvania is a large American Plane tree in Lansdowne, Pennsylvania, located at 47 La Crosse Avenue. This tree is listed in *Penn's Woods 1682–1932* by Edward E. Wildman as well as in Proceedings of the Delaware County Institute of Science issued in January, 1965. Here it is noted that the circumference at DBH was 20 feet, 4 inches. On October 30, 1987 Mr. Maurice E. Hobaugh, District Forester in the Bureau of Forestry, Department of Environmental Resources, Commonwealth of Pennsylvania, wrote a letter to the Greater Lansdowne Civic Association regarding this tree. Measurements are listed as Height: 108 feet; Circumference at DBH: 22 feet, 1 inch; and crown spread: 129 feet. He goes on to state that converting this data to a point system provides a total of 405 points. The champion American Plane tree in Pennslyvania has a total of 422 points. "If a tree is within ten points of a champion, it can be awarded a co-champion title; so the Lansdowne tree is definitely one of the largest American Plane trees in the state."

Unfortunately, the property on which this tree is growing (about 4.5 acres) is now for sale; therefore many citizens of Lansdowne are concerned about the future of this magnificent tree. It is hoped that some plan can be developed that will assure the safety of the tree so that it can continue to survive. ROY L. HILL, JR.

THE MARY GIBSON HENRY FELLOWSHIP. For botanical research preferably to be done on native plants, the fellowship is open to predoctoral or postdoctoral students. The predoctoral fellowship is for three years with yearly review. The postdoctoral fellowship is for two years with potential for an extra year.

Facilities are available for field and laboratory experiments. Predoctoral students are free to obtain their degree at any university of their choice. Preference will be given to students who will carry out a large amount of their research at the Henry Foundation.

The stipend for predoctoral students is $10,000 plus tuition and living facilities. The postdoctoral fellowship will be $22,000 plus living facilities.

Closing date for applicants is June 15, 1988. Awards of fellowship will be made by July 15, 1988.

Submit applications to: Dr. Ruth Patrick, The Henry Foundation For Botanical Research, Box 7, Gladwyne, PA 19035. ELIZABETH P. MCLEAN

Bartonia No. 54: 151–154, 1988

1987 FIELD TRIPS

April 18: Big Elk Creek, Chester County, PA. The third consecutive joint trip of the Philadelphia Botanical Club and the Delaware Valley Fern Society to this area added 47 species to the 1985 plant list, including the following: *Amianthium muscaetoxicum* (1 plant), *Betula lenta, Lyonia ligustrina* (1 plant), *Myosoton aquaticum, Phlox paniculata, Uvularia sessilifolia, Veratrum viride. Epigaea repens* was in full bloom along with numerous violets and other spring flowers; other interesting species observed included numerous rosettes of *Goodyera pubescens, Pyrola rotundifolia,* and *Cardamine impatiens* at its first known Chester Co. station along with *Stellaria pubera*. After the walk Dr. Huttleston regaled us with numerous botanical and scientific poems. Leaders: Dutch Huttleston and Jack Holt.

May 10: Awbury Arboretum, Philadelphia, PA. We named 51 trees, 7 vines, 5 ferns, 9 graminoids, 62 herbaceous plants and shrubs—134 species total. As expected, a few planted exotics were discovered on the long-unused "wild" portion of the Arboretum such as *Betula pendula, Ginkgo biloba, Franklinia alatamaha, Magnolia soulangiana* and *stellata,* and *Styrax japonicus. Pellaea atropurpurea* was the most interesting fern. The grasses and sedges were of the commonest species, but the outstanding vine was *Akebia quinata* of the Lardizabalaceae—it covered ½ an acre—clambering over the tops of all kinds of more mild-mannered plants and shrubs. The herbaceous plants held no surprises, being just what you would expect in an old Philadelphia field. The Arboretum personnel were gracious and very grateful to the Philadelphia Botanical Club for the typed and organized list which Val Udell provided for them shortly after our trip. Leader: Ann Newbold.

May 23: Crossley Preserve, Manchester & Berkeley twps., Ocean County, NJ. In 1984 the NJ Natural Lands Trust (NLT) received this parcel of 251 acres from Amoco Minerals Company as a fee simple donation. Known locally as the Crossley clay pits, this pine barrens tract was mined by the Crossley family of Trenton until the early part of this century. Recognized as a hotbed for the rare corn snake and the now threatened northern pine snake, the area was frequented by such renowned herpetologists as Roger Conant and the late Carl Kauffeld. At least one of the well-known botanists of the early 20th century, John W. Harshberger, was here on a field excursion.

Six distinct plant communities are readily identifiable: (1) abandoned clay pits, (2) undulating "hills" formed by the excavation spoils, (3) abandoned cranberry bogs, (4) upland pine/oak forest, (5) lowland pitch-pine forest, and (6) a cedar-lined stream corridor. Entering the tract from the south, we found along the abandoned Pennsylvania Railroad right-of-way growing side-by-side in abundance *Arenaria caroliniana, Hudsonia tomentosa,* and *Hudsonia ericoides* (the latter two in flower). Patches of *Arctostaphylos uva-ursi* were frequent amid twisted pitch-pine basal sprouts and blackjack oaks. In a nearby pitch-pine lowland we encountered fine flowering stands of *Leiophyllum buxifolium,* carpets of *Pyxidanthera barbulata,* and clumps of *Xerophyllum asphodeloides* with but a single flowering raceme. We concentrated on the abandoned, revegetated clay pits linked by the path of a remnant, narrow-gauge "donkey" railway. Here we saw such specialties as *Muhlenbergia torreyana, Calamovilfa brevipilis, Rhynchospora knieskernii,* and *Carex barrattii.* We searched unsuccessfully for *Arethusa, Schizaea, Listera australis,* and *Uvularia pudica* v. *nitida*. Extreme humidity, threatening storm clouds, and pangs of hunger deterred the group from pressing on to see *Carex livida* and *Breweria pickeringii*, discovered when I did a comprehensive floristic survey for the NLT during the summer of 1985.

A side excursion was taken to Webbs Mill (Lacey Twp.) for the express purpose of seeing *Arethusa bulbosa* in flower. Our final stop was at Whitesbog (Manchester Twp.) to see the prostrate stems of *Breweria pickeringii*. Leader: Ted Gordon.

June 3: Lebanon State Forest, Burlington County, NJ. We visited several habitats in this state forest, including White Cedar swamps, upland pine forest, Pitch Pine lowland, and upland oak forest. Among the species seen in bloom were *Arethusa bulbosa, Hudsonia ericoides, Helianthemum canadense, Xerophyllum asphodeloides, Orontium aquaticum, Minuartia caroliniana, Euphorbia ipecacuanhae, Sarracenia purpurea, Gaylussacia dumosa* and *G. frondosa, Kalmia angustifolia* and *K. latifolia, Rhododendron viscosum, Magnolia virginiana,* and *Krigia virginica*. Other plants noted included *Schizaea pusilla, Helonias bullata, Leiophyllum buxifolium, Carex exilis,* and *Sagina decumbens*. Leader: Karl Anderson.

June 6: Pennypack Watershed Association Wilderness Park, Bryn Athyn Borough and Lower Moreland Township, Montgomery County, PA. Several different habitats were botanized including flood plain forest, alder-button bush swamp, xeric upland forest, railroad vegetation and a spectacular old-growth stand dominated by immense *Liriodendron tulipifera* and *Fagus grandifolia*. One of the participants, Ann Newbold, identified numerous sedges and grasses such as *Carex amphibola, C. blanda, C.* cf. *complanata, C. conjuncta, C. festucacea, C. gynandra, C. muhlenbergii; C. normalis, C. retroflexa, C. rosea, C. scoparia, C. squarrosa, C. stipata, C. stricta, C. swanii, C. virescens, Alopecurus pratensis, Arrhenatherum elatius, Brachyelytrum erectum, Danthonia spicata, Dichanthelium lanuginosum, Glyceria septentrionale, Poa sylvestris,* and *Sphenopholis nitida*. Two of the most significant tree species observed were *Magnolia virginiana* in full bloom and a few *Taxodium distichum* growing in a ditch adjacent to a railroad. Several interesting herbs were seen in the forested areas: *Arabis canadensis, Conopholis americana, Hackelia virginica, Orobanche uniflora* and *Paronychia canadensis*. Leader: John D. Mitchell.

June 20: Whitehouse Station, Hunterdon County, NJ. We explored the wooded area immediately west of the meeting place, and then proceeded to a small pond in Somerst County north of Raritan, NJ. This pond, popularly known as Silver Lake, was formerly part of a private estate. A fine growth of water lily (*Nymphea odorata*) was observed in addition to other aquatic plants, e.g. *Elodea* and *Cabomba*. Along the edge of the pond the following sedges were observed: *Carex stipata, C. annectens, C. vulpinoidea, C. scoparia, C. caroliniana,* and *C. lurida*. Plants abundant in the upland surrounding the pond included *Penstemon digitalis, Rosa multiflora, Saponaria officinalis,* and two species of *Oenothera* (*O. biennis* and *O. fructicosa*). Approximately 25 species of grasses were identified on the walk, which ended with lunch at the leader's home. Leader: Robert C. Meyer, Jr.

June 21–25: Gorham, ME. The 1987 Joint Field Meeting of the Northeastern Section of the Botanical Society of America, the Torrey Botanical Club, and the Philadelphia Botanical Club was housed at the University of Southern Maine. Field trips took place on Monday, Tuesday, and Wednesday. There were 87 participants. The Chairman was Karl Anderson of the Rancocas Nature Center, Mount Holly NJ; and the Secretary/Treasurer was Joan Nowicke, Curator and Palynologist, Botany Department, Smithsonian Institution.

Monday's field trips went to the Kennebunk Plains, a 500-acre coastal sandplain grassland; and to the Saco Heath, a raised peatland with a typical bog flora. Trip leaders were Barbara Vickery and Lissa Widdorf, of the Maine Nature Conservancy. The evening program was "the Unicorn Tapestries and La Dame a la Licorne and their Relationship to the Development of Science in the West" by Dr. Larry Crockett, of the City College of New York.

Tuesday's trips were to Wolf Neck State Park, on the Maine coast east of Freeport; and to the Maine Audubon Society's Mast Landing Sanctuary. Wolf Neck supports a nice mix of coniferous and deciduous forest, and in addition has some small pockets of salt marsh and rocky shore. Mast Landing includes an interesting estuarine habitat along the Harreseeket River, plus mature White Pine Forest and old fields. Leaders were Karl Anderson and Pamela Truesdale. Tuesday evening's program was about "The Furbish Lousewort and other Rare Plants of the Saint John's River Region" by Sue Gawler of the University of Maine.

Wednesday's trips went to Crescent Beach State Park and to Scarborough Marsh. Scarborough is Maine's largest salt marsh. Crescent Beach State Park includes a diverse flora of Spruce woods, dunes, old fields, some small bogs, and an intertidal zone that gives an opportunity to study some of the local marine algae. Leaders were Heather Jacobson, of the University of Maine, and Karl Anderson. Wednesday evening's program was "Mountain Flora of Maine" by Dr. Donald Hudson of the Chewonki Foundation.

The 1988 Joint Field Meeting will focus on the Great Dismal Swamp area of southeastern Virginia. The co-chairs are Larry Klotz and Muriel Poston; the Secretary/Treasurer will be Brenda Erickson.

June 27 and 28: Whittingham Wildlife Management Area, Sussex County, and Johnsonburg, Warren County, NJ. This area, in New Jersey's limestone belt, supports a diverse variety of ferns, one of the largest in the East. Thirty-five species were noted, including *Matteuccia struthiopteris, Dryopteris clintoniana, D. goldiana,* several *Dryopteris* hybrids, *Diplazium pyncocarpon, Asplenium ruta-muraria, A. scolopendrium* (transplanted here many years ago), *A.* × *ebenoides, Pellea glabella,* and *Botrychium simplex* var. *tenebrosum*. Other species of interest include: *Alopecurus aequalis, Carex hitchcockiana, Orchis spectabilis, Liparis loeselii, Quercus muehlenbergii, Ranunculus flabellaris, Clematis verticillaris,* and *Viburnum trilobum*. Leader: Rick Radis.

July 25: Atco, Camden County, NJ. In the Pinelands environments on the western edge of the Wharton State Forest, we searched the right of way under the Public Service electric transmission towers north of the Acto Dragway for a mid-summer floral display. The course led the group through pine-oak upland knolls formed on the ancient river levee terraces that parallel the present Mullica River headwater channel. Many open sandy areas were found that appeared to be ideal for *Breweria pickeringii*, but no plants were discovered. The walk passed through pitch pine lowlands, a white cedar swamp, and small isolated wetlands known locally as spongs. This area provided a good look at many common species such as the common heaths and some interesting species such as *Rhynchospora pallida, Cyperus flavescens, Juncus scirpoides, Juncus pelocarpus, Lilium superbum,* and *Habenaria blephariglottis*. The day ended at an area known as Oak Knoll, from which we retuned to our vehicles and departed. Leader: Joe Arsenault.

August 1: Johnsonburg, Warren County, NJ. Ferns and fern allies were particularly evident, including such calciphiles as *Pellaea glabella, Asplenium ruta-muraria, A. trichomanes, Camptosorus rhizophyllus, Woodsia obtusa, Cystopteris fragilis,* and *C. bulbifera,* all of which were growing on the sides of railroad cuts through limestone, along with such species as *Potentilla fruticosa, Liparis loeselii, Senecio obovatus,* and *Campanula rotundifolia*. Additional plants of interest to trip participants included *Goodyera pubescens, Cypripedium calceolus, Bulbostylis capillaris, Oryzopsis racemosa, Quercus muehlenbergii, Verbascum lychnites, Geranium sibiricum, Pycnanthemum incanum, Cunila origanoides, Chaenorrhinum minus, Cicuta bulbifera* (growing on a pond edge near the tracks), and *Carex comosa* (in the same location). Leader: Karl Anderson.

August 23: Smedley Park, Delaware County, PA. On this joint trip with the Delaware Valley Conservation Society, Inc., we visited several interesting wild flower sites in this creek valley park. The status for the Leafcup *(Silphium perfoliatum)* was in full bloom and participants were dismayed to hear that next year this station will be destroyed by construction of the Blue Route, a four-lanes highway system. The Delaware Valley Conservation Society, Inc., has already transplanted a number of plants to appropriate localities in Ridley Creek State Park and Rose Tree County Park where they can be monitored and protected for future botanists to enjoy. In 1988 a major plant rescue project will be launched to save as many plants as possible from this locality. The summer flora was well represented with the exception of a small station (about 6 plants) of *Oenothera lacinata* which may have been eliminated by ballfield mowing. Field trip participants were invited to visit the newly opened Butterfly Garden at Ridley Creek State Park where they saw many of our native flowers and cultivars being used to supply a secondary food source for local butterfly species—a necessity for survival of these important insect pollinators in this county! Their natural habitats are being destroyed on an enormous scale because of the demand for housing, highways, malls, parking lots and all the other "hall marks" of a decline in our natural environment. Leader: James K. McGrath.

September 11: Hopewell Furnace National Historic Site, Berks County, PA. We looked at forest areas on the north and south side of French Creek near the visitors center for differences related to bedrock geology. On the gabbro on the hill south of the creek we noted the absence of *Betula lenta,* the presence of *Betula alleghaniensis,* and an ericaceous understory. We spent quite a bit of time debating the identity of *Quercus coccinea, rubra,* and *velutina*—all three species occurred here. Careful searching by trip participants added several species to my checklist for the site, including *Corallorhiza odontorhiza,* which was in flower. Leader: A. E. Schuyler.

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23 Apr	Native Plants & Wildflowers for Your Garden	F. M. Mooberry
28 May	Review of 1986–1987 Field Trips	J. Arsenault
24 Sep	Illustrated Report of Summer Botanizing, and Several Years of Club Field Trips	J. Arsenault
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19 Nov	Progress Towards a New Edition of the Gleason & Cronquist Manual	A. Cronquist
17 Dec	Overlooked Collections of John Bartram	E. P. McLean, A. E. Schuyler

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Commemorative Issue: Louis Edwin Hand

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Bartonia No. 55: 1–3, 1989

Louis Edwin Hand (1901–1988)

TED GORDON
29 Burr's Mill Rd., Vincentown, NJ 08088

On December 8, 1988, the botanical world lost an extraordinary amateur field botanist and a cherished companion, Louis Edwin Hand. A victim of Paget's disease (diagnosed in 1983), a disruption of the bones' normal maintenance system, Lou was exceedingly distraught when he first realized that he would no longer be able to go afield to see his beloved wildflowers. Yet, he endured this insidious disease—spending his last three years and three months in a convalescent home in Mt. Holly, NJ—with remarkable composure and dignity.

Born in the Holmesburg section of Philadelphia on August 1, 1901, Lou Hand attended local schools, including Frankford High. His studies at the Spring Garden Institute led to lifelong employment at the Electric Storage Battery Company in Philadelphia. In 1963 he retired as a commercial laboratory supervisor.

Lou's entry into the Boy Scouts as a lad of twelve kindled his interest in the out-of-doors. Reading the works of Samuel Scoville, Jr. and Dr. Charles C. Abbott intensified his enthusiasm for natural and local history. Soon, a project in tree identification and attainment of a merit badge in botany launched his "career" as a botanist. In 1932, Lou married Eileen Brown, who shared his love for scouting and nature and who survives him.

The thirties were formative years of intensive, independent botanical study. Gray's 7th edition and "Britton and Brown" became Lou's constant companions. He took copious notes, particularly of taxonomic keys, and carried them with him wherever he went, entrusting them to memory. With his wife, Lou took a four-year course in botany (1934–1937) at Wagner Free Institute of Science under George B. Kaiser. This was the extent of his formal education in botany! Attending numerous lectures and field trips conducted by Walter Steckbeck, John Fogg, Walter Benner, Hugh Stone, Francis Pennell, and Edgar Wherry honed his botanical insight. He became a member of the Botanical Society of Pennsylvania, the Philadelphia Botanical Club (1936), the Torrey Botanical Club (1939), the Academy of Natural Sciences, the Comstock Society, and the Philophytes. Lou developed a close friendship with Dr. Wherry, and the two frequently were co-leaders of field trips, especially for the Academy's "Expeditions for Everyone." Long-time Torrey members will recall fond memories of sojourns in the Pine Barrens or at the Jersey Shore under Lou's leadership in the late 1940s and early 1950s with overnight accommodations at the Hands' bungalow at Malaga.

Cape May County, NJ, held a special fascination for Lou, both floristically and historically. Here his father, Joseph Addison Hand, was born and as a builder and contractor constructed several homes in Wildwood Crest, among them a summer cottage for the family. Here his family traced its English ancestry back to Shamgar Hand (1692). Here Lou forged strong bonds with Otway H. Brown and Robert Alexander. Upon the death of the former in 1947, Lou inherited Brown's unofficial title of "the botanical authority of the county." With the latter, now deceased, he co-authored *Trees and Shrubs of Cape May County, New Jersey* (1965).

Beginning in 1943, Lou developed a strong friendship with Hollis Koster, an erudite "piney" who had his roots in Green Bank, on the lower Mullica River. Their relation-

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Lou Hand at Hampton Furnace, September 1982. Photo by T. Gordon.

ship led to intensive exploration of the Jersey Pine Barrens and put them in frequent touch with Bayard Long, who delighted in hearing reports of their finds and tolerated their incessant inquiries.

Not totally limited to the surveillance of flora, Lou's interests included geology, birding, and documenting local fauna. He enjoyed listening to classical music, reading poetry, and researching his German heritage on the side of his mother, Maria Schmalzridt. But above all, Lou derived his greatest joy from leading trips into the field and sharing his storehouse of knowledge.

Although he published little, his value lay in contributing his thorough field knowledge to others. In Forman's *Pine Barrens: Ecosystem and Landscape* (Academic Press, 1979), Hand co-authored with Wayne Ferren and John Braxton a chapter titled "Common Vascular Plants of the Pine Barrens." His field trip summaries in *Torreya* provide invaluable documentation of some of our local flora. Additionally, Lou generated plant lists of several state-owned lands in New Jersey, among them Wharton State Forest and Cheesequake and Parvin State Parks. Lester Thomas's *The Pine Barrens of New Jersey* (1967), Jack McCormick's *The Pine Barrens: A Preliminary Ecological Inventory* (1970), Robichaud/Buell's *Vegetation of New Jersey* (1973), and *Newcomb's Wildflower Guide* (1977) acknowledge his contributions. In 1970 both Lou and his wife collaborated with NBC in producing *The Paradoxical Wilderness,* a documentary television special on the Pine Barrens. From 1964 into the early 1970s, Lou served as a frequent consultant to the New Jersey State Museum in their development of dioramas of Island Beach and Martha Bog. For a time he also served on the Governor's Natural Areas Council, on the Board of Directors of NJ Audubon Society, on the Penn's Wood Committee (PA), and as a member of a spectrum of other conservation organizations. As charter members of the Pine Barrens Conservationists, both Hands played active roles in developing educational programs and a superb nature trails system at Batsto. The state even hired them as canoe guides to interpret the scenic resources of the region. Vehemently opposing any efforts to promote development of the Pine Barrens, the Hands championed the formation of a Pine Barrens National Monument.

While Lou Hand's reputation for his knowledge of the flora of the New Jersey Pine Barrens has become legendary, it must be stressed that he felt equally at home in the other physiographic provinces of the state. Moreover, he was intimately acquainted with the floras of Pennsylvania, Delaware, New York, Massachusetts, Vermont, New Hampshire, Maine (member of Josselyn Botanical Society), and Florida. Recalling a 1970 Academy sponsored trip to Tannersville Bog in the Poconos, Alfred E. Schuyler fondly remembered: "Lou's enthusiasm for the Pocono flora was comparable to what he had for the Pine Barrens, and I recall his delight when he found the dwarf mistletoe in bloom on black spruce along Cranberry Creek. Although Lou and I were co-leaders of the trip, I learned a lot more from him than he did from me." Similarly, Lawrence Crockett candidly stated: "Lou was not a professor, but he knew much more than many who are and that includes me. I know that professionals of national status sought his advice and opinion in botanical disputes.'' It was precisely such invaluable assistance that Lou gave to various individuals and agencies, especially on matters pertaining to the Pine Barrens, that prompted Dorothy Evert to refer to him as a ''national treasure.'' In the words of David E. Fairbrothers, who had collaborated with him since 1954, ''Lou's death has contributed to biological impoverishment for the Pinelands, because this sincere and willing mentor is not available for future consultation.''

Lou Hand's life was exemplary. All who came in touch with him were impressed not only by his knowledge but equally by his sincerity, integrity, tolerance, kindness, and humility. Frank Hirst reduced the essence of Lou to very simple but profound terms: ''Everyone who met and knew Lou Hand liked him. He was never too busy to help and teach, and you never felt like he thought you should know something; in fact, all would agree that he often seemed embarrassed that he knew so much. He was that type of person.''

Alfred E. Schuyler has left us with a challenge that, if fulfilled, will enable us to pay homage to a man that has so indelibly affected us. ''Lou wanted to see an updated book on the flora of the Pine Barrens published. He did not live to see it, and a guide to the unusual flora of the Pine Barrens is still needed. Maybe if enough of us perpetuate Lou's energy and spirit, we'll get that guide some day.''

ACKNOWLEDGMENTS

For their input, I would like to express my appreciation to L. Crockett, D. Fairbrothers, E. Hand, F. Hirst, and A. E. Schuyler. Special thanks goes to the latter for reviewing this account.

Bartonia No. 55: 4–14, 1989

Rafinesque's *Florula Delawarica*[1]

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The life and times, travels and journals, publications and correspondence of Constantine Samuel Rafinesque-Schmaltz (1783–1840) are representative of an important period in the development of North American botany (Stuckey 1986). Robert R. Tatnall (1946), in his *Flora of Delaware and the Eastern Shore,* commented on the collections and *Florula Delawarica* by Rafinesque: "this work was never published, and the manuscript is lost. After Rafinesque's death his herbarium became widely scattered, so that there is small chance of locating the specimens from our state."

For those interested in mid-Atlantic floristics in general and Del-Mar-Va floristics in particular, the possibility of finding Rafinesque's lost *Florula Delawarica* is an exciting challenge! Although we, as well as many others (apparently including Rafinesque himself) have failed to relocate this lost treasure, it has not been for want of searching. We endeavored to locate Rafinesque's *Florula Delawarica* in the collections of Benjamin Smith Barton at the American Philosophical Society, Boston Public Library, The Historical Society of Pennsylvania, and the Library of Congress and the correspondence of Henry Ernest Muhlenberg at The Historical Society of Pennsylvania.

While we cannot locate an extant copy of the manuscript itself, perhaps we may yet reconstruct a portion of Rafinesque's "little flora of Delaware" from published and unpublished sources, including surviving letters and herbarium specimens. In this regard, we were encouraged by the efforts of E. L. Little (1943) to reconstruct Rafinesque's *Florula Columbica*.

This paper reports on the results of our searches and builds upon the work of many others. In our efforts to reconstruct Refinesque's list, we have good evidence—and reasonable scientific supposition—to support a minimum Delaware list which included 55 vascular plants, eight fungi, and one lichen.

Our reconstructed list may be the best that can be done with the known literature and auxillary sources. We hope, however, that it will serve as a challenge for those interested in historical floras to continue the botanical treasure hunt for Rafinesque's lost manuscripts. Those with a serendipitous outlook may find the hunt, itself, as rewarding as the treasure!

RAFINESQUE'S *FLORULA DELAWARICA*

At the age of 18, Rafinesque landed at Philadelphia on 18 April 1802 with his younger brother, Anthony A. Rafinesque. From 1802 to 1803 they travelled throughout Pennsylvania and New Jersey and made acquaintances with the naturalists of the area. In May 1804 the elder Rafinesque made his first sojourn in the state of Delaware. Rafinesque wrote in his *Life of Travels* (Rafinesque 1835):

---

[1] Contribution No. 11 from the Claude E. Phillips Herbarium.

> I crossed [Delaware] lengthways from North to South, returning by the Western shore of Maryland [apparently Western shore of Del-Mar-Va in Maryland, not Western shore of Maryland]. I travelled 300 miles on foot in May and June. My friend Col. [Thomas] Forrest had given me Letters for Mr. MacLane, Senator [Col. Allen McLane], and Dr. [James] Tilton, both of Wilmington, who gave me a friendly reception, and furnished me with circulars for their friends through the State, whereby I was treated with great hospitality wherever I went, and began to experience the kind feelings of the Southern planters. I was even offered horses to ride, but I preferred my pedestrian mode, although I had often to wade through streams and swamps. I went through Dover, small borough, metropolis of this small State, and visited the Governor [Col. David Hall] of the State at his plantation [in 1790 Col. Hall had constructed his residence at 107 King's Highway, Lewes].
>
> At Lewistown [Lewes] I was well received by the Rev. Mr. [James Patriot] Wilson, and went thence to Cape Henlopen, to visit the downs [dunes], the light house, and the Sea shore, to collect Crabs, Shells and Sea plants. At Dagsborough Mr. [William Hill] Wells [son-in-law of General John Dagworthy and owner of the Dagworthy estate since Dagworthy's death in 1784] sent me with an Oxen wagon into the great Dismal [Cypress] Swamp [Del-Mar-Va, not Virginia], one of those singular Cypress Swamps of the Sea shore region. The *Cupressus thyoides* [*Chamaecyparis thyoides* (L.) Britton, Sterns & Poggenb.] and *disticha* [*Taxodium distichum* (L.) L. C. Rich], two species of Cypress, are the chief trees found in it; but this is also the northern limit of many southern trees and plants, such as *Hopea tinctoria* [*Symplocos tinctoria* (L.) L'Hér.], &c. These swamps are very different from others, the waters are shallow, colored like beer yet clear. Roads are made into them with trees laid across.
>
> Many geographical observations were made in this journey, where I began to study the soil, swamps, sands, downs [dunes], marls, islands, strata and fossils of those vast littoral atlantic plains which extend 2000 miles from New Jersey to Florida and Louisiana. The low sandy islands which skirt all the atlantic shores from Long Island to Yucatan, are a very peculiar feature of the physical geography of this continent, which has hardly been noticed; altho' it has scarcely any parallel elsewhere. These islands become often peninsulas as it were under our own eyes.
>
> On my return, I went in to East Maryland, visiting Easton and Chester. I dwelt awhile on the shores of the Chesapeak, and came back by Christiana and Wilmington in Delaware. This journey in the great peninsula of Chesapeak afforded me many rare and new plants with other natural objects.

In mid-July of 1802 E. I. du Pont moved his family from Bergen Point, New Jersey to establish his powder mills (now Eleutherian Mills-Hagley Foundation, Inc.) on Brandywine Creek near Wilmington, Delaware. Through John Vaughan, merchant, powder agent, and secretary of the American Philosophical Society, du Pont made the acquaintance of Rafinesque. In the fall of 1804 du Pont entertained Rafinesque at his home, and Rafinesque botanized in the nearby Brandywine woods (Wilkinson 1972).

On 12 December 1804, Rafinesque wrote to E. I. du Pont from Philadelphia:

> I am very sorry that you did not return to town at the time you mentioned, for if your visit is much delayed I shall not have the pleasure of seeing you. I have just had letters from my family in Italy that recall me immediately, and as a ship is ready to sail for Livourne I am going in a few days. If you are not in town before then, I will leave with Mr. Vaughan the Book [Michaux's *Flora Boreali-Americana*] you were good enough to lend me. My departure for Europe is most unexpected. Who would have thought of it when I planned with you to see the Brandywine again next year, and afterward to visit the Western country! I have made my preparations so hurriedly that I have scarcely had time to pack my plants. I much regret the hickory nuts that I left at your house. We agreed with Dr. Barton to call *lennixylum* the kind of hickory that is so different from the Juglans, and I have five species—L. angulosa [*Carya ovata* (Mill.) K. Koch], amara [*C. cordiformis* (Wang.) K. Koch], pyriforme [*C. glabra* (Mill.) Sweet], squamosa [*C. ovalis* (Wang.) Sarg.] and globosa [*C. tomentosa* (Poir.) Nutt.]. You will recognize them by the names and you will see them in my Florula Delawarica, which I have given to Dr. Barton for his paper (B. G. du Pont 1925).

When Rafinesque returned to Italy on 1 January 1805, sailing from New Castle, Delaware, he took with him nearly 10,000 herbarium specimens from Delaware, the District of Columbia, Maryland, Pennsylvania, and Virginia (Rafinesque 1836; Little 1943).

In a letter dated 8 August 1805 to the Rev. ("Dr.") Henry Ernest Muhlenberg of Lancaster, Pennsylvania, Rafinesque wrote:

> You will have been sent by Dr. [Benjamin Smith] Barton my 2 little florulas—Delawarica & Columbica—where you will have perceived many synonimies of Michaux & others. That little Essay was however done in such a hurry for a sort of remembrance of my stay in America that I have since detected Myself some improper applications, but they will have stroke you & you no doubt have been able to correct them.

In 1806, Benjamin S. Barton's journal, *The Philadelphia Medical and Physical Journal,* announced: "Mr. Rafinesque, an Italian gentlemen, has put into the hands of the Editor, a MS. catalogue of the plants of the State of Delaware, and of the District of Columbia. This catalogue, with large additions by the Editor, will be published in future parts of this *Journal*" (Barton 1806). Barton never published Rafinesque's catalog.

In 1815, Rafinesque published *Analyse de la Nature,* a work which contained on the cover pages lists of his works and essays, including:

> 2. Florula Delawarica et Florula Columbica—Catalogue des Plantes de l'État de Delaware et du district de Columbia dans l'États Unis d'Amérique, communiqué au Doct. Barton pour insérer dans le Journal de Physique de Philadelphie en 1805.

In 1816, Rafinesque, in his first publication after returning to the United States, listed his works and tracts up to that date and included:

> Florula Delawarica, or a Catalogue of the Plants found in the State of Delaware. This tract and the following [Florula Columbica] were given to Dr. Barton in 1804, for insertion in his Medical and Physical Journal, and he promised to do so, volume II, page 177; but never performed his promise.

Rafinesque further explained that all his books, manuscripts, drawings, and herbarium specimens were lost when his ship, "Union of Malta," sailing from Sicily to New York, was wrecked off Fishers Island near New London, Connecticut on 2 November 1815. Thus, if Rafinesque had kept a copy of his *Florula Delawarica,* it was lost in the shipwreck.

Later, Rafinesque (1833) again reiterated his disappointment with Barton, when he published another list of his works, including: "1804, Floras of Delaware and District of Columbia, my first essay, suppressed by Dr. Benjamin Barton."

Rafinesque, in spite of his difficulty in publishing in America, continued to work, correspond, and publish in both Europe and North America (Stuckey, 1986). From the sources listed below and from those previously quoted, we have attempted to reconstruct a portion of Rafinesque's *Florula Delawarica.*

PRIMARY SOURCES FOR RAFINESQUE'S *FLORULA DELAWARICA*

On 1 September 1807, Rafinesque wrote a letter from Palermo, Italy to Dr. Samuel L. Mitchell and listed new genera and species that he discovered in the United States during his travels of 1803–1804 (Rafinesque 1808b). In this published letter he listed two fungi, one lichen, and ten species of higher plants that he had collected in Delaware.

In 1808, a prospectus of Rafinesque's two intended works was published with a new cryptogam from Delaware (Rafinesque 1808a).

On 1 April 1810, Rafinesque again wrote a letter from Palermo to Dr. Samuel L. Mitchell. In this letter he listed his mid-Atlantic plants which he believed were naturalized in the United States from Europe and other parts of the U.S. (Rafinesque 1811a). In this published letter he cited 18 species he had collected in Delaware.

On 1 April 1810, Rafinesque wrote another published letter from Palermo and listed one species of *Callitriche* and four species of *Potamogeton* that he had collected in Delaware (Rafinesque 1811b).

On 7 January 1811, the Rev. Muhlenberg wrote to Dr. William Baldwin, then living in Wilmington, Delaware (Darlington 1843):

> The State of Delaware, alone, amongst all others, has contributed nothing to my Herbarium; and I am certain it contains many new and curious plants. This, a former acquaintance of mine, Mr. Rafinesque, has informed me of; and Mr. William Hamilton, of the Woodlands, confirms his information.
>
> I have seen part of Mr. Rafinesque's catalogue,—amongst the plants he mentions, several were new to me,—as *Uniola paniculata* [*U. latifolia* Michx.], *Zizania miliacea* [*Z. aquatica* L.], *Hydrocotyle ficarioides* [*Hydrocotyle ranunculoides* L.], *Hopea tinctoria* [*Symplocos tinctoria*], *Sida rhombifolia* [*S. spinosa* L.], *Astragalus Carolinianus* [*A. canadensis* L. var. *canadensis*], *Jacobaea tomentosa* [*Senecio tomentosus* Michx.] and *lyrata* [*S. aureus* L.], *Helianthus lanceolatus* [*H. decapetalus* L.], *Viola rotundifolia* [*V. rotundifolia* Michx.], *Veratrum nigrum* [*V. viride* Ait.], *Melanthium racemosum* [*M. hybridum* Walt.], *Blechnum Virginicum* [*Woodwardia virginica* (L.) Sm.], &c.

In 1812, Benjamin S. Barton published a *Flora Virginica* and listed two species which were apparently in the *Florula Delawarica:* "*Bartonia tenella*. [*B. virginica* (L.) Britton, Sterns & Poggenb.]—Rafinesque, Florula Delavarica et Columbica, M.S." and "*Bartonia verna*. [*B. verna* (Michx.) Raf. ex Barton]—Rafinesque, Florula Delavarica et Columbica, M.S."

In 1813, Rafinesque wrote an article which included five fungi from Delaware.

In 1814, Rafeinsque published *Précis des découvertes et travaux somologiques,* a work which listed four fungi collected in Delaware. The descriptions are similar, but not identical, to those published in 1813.

Rafinesque's self-admitted uncontrolled and uncontrollable tendency to rush into print with many new taxa has, from the beginning, produced many critics (Stuckey 1986). However, Rafinesque's works have provided twentieth century botanists with countless opportunities to apply the rules of the *International Code of Botanical Nomenclature*. We, too, have taken up this challenge of synonymy in our list, perhaps with a little appreciation. A hasty critical dismissal of Rafinesque and his works does not give credit to the species which he named and which still stand today (e.g., *Drosera filiformis*). While he was ignored by his contemporaries, Rafinesque has generated progressively greater interest in twentieth century botanists (Stuckey 1986).

RECONSTRUCTION OF RAFINESQUE'S *FLORULA DELAWARICA*

Although it is very hazardous to venture identifications without herbarium vouchers, the following species were apparently in Rafinesque's small flora. Identifications are primarily based upon plant distributions in Delaware (Tatnall 1946) and synonymies in Fernald (1950), Kartesz and Kartesz (1980), and Merrill (1943, 1949). In the following catalog we have quoted Rafinesque exactly and completely because of the obscurity of the letters and journals. Previously unpublished names are listed without authority. This list should not be interpreted as an attempt at valid publication of these names.

FUNGI

Agaricus aterrimus Raf. = ?

"*Agaricus aterrimus*. Entiérement noir, stipe fistuleux, lisse, contigu; peridie lisse, convexe-conique diamètre, de la moitié de la longueur du stipe. En *Delaware*." (Rafinesque 1813).

"*Amanita aterrima*. Entièrement noir, stipe fistuleux, lisse, contigu; péride lisse, convêxe-conique, diamètre la moitié de la hauteur du stipe. *Dans l'état de Delaware*." Refinesque 1814).

Agaricus azureus Raf. = ? *Lactarius indigo* (Schwein.) Fr.?

"*Agaricus azureus*. Couleur azuré; stipe court semifistuleux, continu; diamètre du peridie convexe, ombiliqué, quadruple, de la longueur du stipe, lames décurrentes bleues. En *Delaware*." (Rafinesque 1813).

"*Amanita azurea*. Entièrement azuré, stipe demi fistuleux et continu; péride à diamètre quadruple de la hauteur du stipe, convêxe, ombiliqué, lames bleues décurrentes. *En Delaware*." (Rafinesque 1814).

Dycticia clathroides Raf. = ? misidentification of *Clathrus columnatus* Bosc?

"Dycticia, (clathroides) akin to clathrus, but without volva. Found in Delaware." (Rafinesque 1880a).

Hydnum aurantium Raf. = ? *Pycnoporus cinnabarinus* (Jacq. ex Fr.) Karst?

"*Hydnum aurantium*. Stipe blanc tuberculeux, de la longueur de diamètre du peridie qui est convexe en-dessus, lisse et de couleur orangé claire; papilles subulées, incarnat-orangé Dans les bois, en *Delaware*." (Rafinesque 1813).

"*Hydnum aurantinum*. Stipe blanc tuberculé, de la longueur du diamètre du péride qui est convêxe supérieurement, lisse, orangé pale, dessous concave à papilles subulées orangées incarnates. *En Delaware*." (Rafinesque 1814).

Hydnum barbatum Raf. = ? *Hericium erinaceus* (Fr.) Pers.?

"Hydnum barbatum, bearded hydnum; pedunculated, whitish, peridium obovated, irregularly truncated, barb slender. Found near Lewistown, in Delaware." (Rafinesque 1808b).

Hydnum puniceum Raf. = ? *Fistulina hepatica* Schaeff. ex Fr.?

"*Hydnum puniceum*. D'une couleur écarlate; sessile, plane, solitaire, lisse; papilles inférieures d'un rouge brun. Sur les arbres, en *Delaware*." (Rafinesque 1813).

"*Hydnum puniceum*. Ecarlatte, péride sessile plane solitaire lisse, papilles congeâtres. *Sur les arbres en Delaware*." (Rafinesque 1814).

Lycoperdon coccineum Raf. = ? *Rhizopogon rubescens* Tulasne? or ?*R. roseolus* (Corda) Hollos?

"*Lycoperdon coccineum*. Couleur rouge; sessile, globuleux, presque lisse; dehiscence arrondie, poussière brune rougeâtre. Croît dans les bois de *Delaware*." (Rafinesque 1813).

"*Lycoperdon coccineum*. Rouge sessile globuleux, presque lisse, déhiscence arrondie, poussière brune-rougeâtre. *Amér. Sept. dans les bois en Delaware*." (Rafinesque 1814).

Peziza cupularia Ref. = ? *Tarzetta cupularis* (L. ex Fr.) Lamb?

"Peziza cupularia; cupped peziza; semi-pedunculated yellowish, long campanulated. In Delaware." (Rafinesque 1808b).

LICHEN

Druparia rosea Raf. = ? *Baeomyces roseus* Pers.?

"10. Druparia. Crypt. fungus; natural order of the mushrooms; gelatinous, containing a carilaginous peridium, in which the seeds are dispersed in a mucilaginous substance. 1 *D. violacea*, pruniform, violaceous. I have found it near Philadelphia 2 *D. rosea*, semi-ovate, of a pale rose colour; found near Wilmington, in Delaware. 3 *D. globosa*, globular, cherry-like, reddish, found near Easton, Pennsylvania." (Rafinesque 1808b).

FERN

BLECHNACEAE

Blechnum virginicum L. = *Woodwardia virginica* (L.) Sm. (Darlington 1843).

GYMNOSPERMS

TAXODIACEAE

Cupressus disticha L. = *Taxodium distichum* (L.) L. C. Rich. (Rafinesque 1836).

CUPRESSACEAE

Cupressus thyoides L. = *Chamaecyparis thyoides* (L.) Britton, Sterns & Poggenb. (Rafinesque 1836).

ANGIOSPERMS: MONOCOTS

POTAMOGETONACEAE

Potamogeton diversifolium Raf. = *P. diversifolius* Raf.

"Potamogenton diversifolium (Raf.—*P. hybridum* b. Mich. fl. bor.) foliis submersis, linearibus, acutis sessilibus, emersis, oblongo-ovalibus, natanibus, spicis cilindricis.—in Carolina, Virginia et Delawara." (Rafinesque 1811b).

Potamogeton filiforme Raf. = *P. pectinatus* L.

"Potamogeton filiforme (Raf.) foliis filiformibus, longissimis, subsessilibus, acutis, spicis terminalibus paucifloris.—in Delawara." (Rafinesque 1811b).

Potamogeton foliorum Raf. = *P. foliosus* Raf.

"Potamogeton foliorum (Raf.—*P. gramineum* Mx. fl. bor. Amer. *nec. Linn.*) foliis Sessilibus, anguste linearibus, obtusiusculus, spicis Sub. 4. floris—in Carolina, Virginia et Delawara." (Rafinesque 1811b).

Potamogeton petiolaris Raf. = *P. nodosus* Poir.

"Potamogeton petiolaris. (Raf.). foliis linearibus, obtusis, longe petiolatis) spicis brevibus subcilindricis. —in Delawara." (Rafinesque 1811b).

POACEAE

Avena elatior L. = *Arrhenatherum elatius* (L.) Beauv. ex J. & C. Presl.

Festuca elatior L.

"Festuca elatior, Avena elatior, lately introduced into the meadows near Lancaster, and Wilmington in Delaware—rather rare." (Rafinesque 1811a).

Uniola paniculata = *U. latifolia* Michx. (Darlington 1843).

Zizania miliacea = *Z. aquatica* L. (Darlington 1843).

LILIACEAE

Melanthium racemosum = *M. hybridum* Walt. (Darlington 1843).

Ornithogalum umbellatum L.

"Ornithogalum umbellatum—common—in some parts of New-Jersey and Delaware, near Lancaster, &c. in fields, meadows and gardens." (Rafinesque 1811a).

Veratrum nigrum = *V. viride* Ait. (Darlington 1843).

AGAVACEAE

Yucca filamentosa L.

"Yucca filamentosa—from the Southern States: found in Delaware and near Havre de Grace." (Rafinesque 1811a).

SMILACACEAE

Smilax heterophylla Raf. = *S. glauca* Walt.

"Smilax heterophylla, heterophyllous sarsaparilla; stem angular, unarmed; leaves ovate-semi-cordated, or ovate-lanceolated, obtuse 7 nervous, umbells axillary, many flowers. It grows in several woods of Delaware, and the eastern shore of Maryland." (Rafinesque 1808b).

ANGISOPERMS: DICOTS

JUGLANDACEAE

Lennixylum amara = *Carya cordiformis* Wang.) K. Koch (du Pont 1925).

Lennixylum angulosa = *Carya ovata* (Mill.) K. Koch (du Pont 1925).

Lennixylum globosa = *Carya tomentosa* (Poir.) Nutt. (du Pont 1925).

Lennixylum pyriforme = *Carya glabra* (Mill.) Sweet (du Pont 1925).

Lennixylum squamosa = *Carya ovalis* (Wang.) Sarg. (du Pont 1925).

FAGACEAE

Quercus suberoides Raf. = *Q. muhlenbergii* Engelm.

"Quercus suberoides, suberous-oak; leaves lanceolated, very acute, smooth, unequally semi-dentated, bark suberous in Newcastle county, Delaware, and Berks county, Penn." (Rafinesque 1808b).

POLYGONACEAE

Polygonum inundatum Raf. = *P. hydropiperoides* Michx.

"Polygonum inundatum, inundated; stem upright, semi-angular, leaves alternated, petiolated linear-lanceolated, very acute, spike terminal, flowers 8 androus, 2 gynous; grows in the swamps of Sussex county, in

Delaware, to the height of one or two feet under water; the flowers are always above it, and always of a white rose-colour." (Rafinesque 1808b).

NYCTAGINACEAE

Mirabilis dichotoma L. = apparent misidentification, probably *M. jalapa* L.

"Mirabilis dichotoma—in Pennsylvania, Maryland and Delaware." (Rafinesque 1811a).

CARYOPHYLLACEAE

Cerastium velutinum Raf. = *C. arvense* L. var. *arvense*.

"Cerastium velutinum, velvet mouse-ear; stem procumbent; leaves ovate, elliptic, obtuse, tomentous, flowers few, terminal. In Newcastle county, Delaware, and Chester county, Penn." (Rafinesque 1808b).

Spergula arvensis L.

"Spergula arvensis—common—particularly in Delaware and New-Jersey, in flax fields." (Rafinesque 1811a).

RANUNCULACEAE

Aquilegia vulgaris L.

"Aquilegia vulgaris—in Delaware, near Lanc. and Washington, near Germantown, rare—near gardens, or along roads." (Rafinesque 1811a).

BRASSICACEAE

Cochlearia armoracia L. = *Armoracia rusticana* P. Gaertn., B. Mey. & J. Scherb.

Lepidium sativum L.

Myagrum sativum L. = *Camelina sativa* (L.) Crantz

"Lepidium sativum, Myagrum sativum, Cochlearia armoracia, in Delaware and near Lancaster, do. [near houses] do in New-Jersey, & do., rare—near gardens." (Rafinesque 1811a).

Sinapis alba L.

Sinapis nigra L. = *Brassica nigra* (L.) W. D. J. Koch

"Sinapis alba, nigra, rather common—near Lancaster, Newark, &c. and in Delaware, near houses." (Rafinesque 1811a).

DROSERACEAE

Drosera filiformis Raf.

"Drosera filiformis, filiformous sundew; leaves radical filiformous, adspersed of pedicilated glands, stems terminated with a spike of unilateral flowers. It grows in marshly grounds in the county of Glocester, New Jersey, and Sussex county, Delaware." (Rafinesque 1808b).

ROSACEAE

Prunus spinosa L.

"Prunus spinosa—rare—in some hedges and fields, in Maryland, New-Jersey, and Delaware." (Rafinesque 1811a).

FABACEAE

Astragalus Carolinianus L. = *A. canadensis* L. var. *canadensis* (Darlington 1843).

Medicago sativa L.

"Medicago sativa—rare—in some fields of Maryland and Delaware." (Rafinesque 1811a).

CALLITRICHACEAE

Callitriche terrestris Raf. = *C. terrestris* Raf. emend. Torr. (*C. austinii* Engelm.).

"Callitriche terrestris (Muhlenberg Mss.) Caule humifuso, foliis omnibus petiolatis, ellipticis, obtusis, integris, crassis, enervibus, floribus, monoicis.—In Pennsylvania, Nova Cesarea, Delawara, in locis humidiusculis." (Rafinesque 1811b). Malvaceae.

Sida rhombifolia = *S. spinosa* L. (Darlington 1843).

VIOLACEAE

Viola rotundifolia Michx. (Darlington 1843).

ONAGRACEAE

Ludwigia aurantiaca Raf. = *L. alternifolia* L.

"Ludwigia aurantiaca, oranged ludwigia; stem upright branched, leaves sessile, ovate-lanceolated, alternated, acute, smooth, flowers axillary, petals equalling in length the calix. I found it in Newcastle county, Delaware, and Chester county, Pennsylvania; the petals are of an orange colour." (Rafinesque 1808b).

HALORAGIDACEAE

Burshia humilis Raf. = *Myriophyllum humile* (Raf.) Morong

"3. Burshia. Tetrandria tetragynia:————akin to the prosperinaca, calyx superous 4 dentated, corolla 0, stam. 4, styles 4 subdulated, capsul, 4 locular, 4 spermous. *B. humilis humble burshia,* leaves pinnatifid, divisions incised, pinnatifid, acute; flowers axillary, solitarious sessile. This new plant was first discovered by Mr. Bursh [Frederick T. Pursh], in New Jersey. I have since found it in the county of Sussex, state of Delaware; it is an aquatic plant, which only rises to the height of a few inches." (Rafinesque 1808b). This genus was later published as *Purshia* (Rafinesque 1815).

APIACEAE

Anethum foeniculum L. = *Foeniculum vulgare* Mill.

"Anethum foeniculum—in Delaware, and in Pennsylvania, near Bethlehem, along some roads." (Rafinesque 1811a).

Hydrocotyle ficarioides = *H. ranunculoides* L. (Darlington 1843).

SYMPLOCACEAE

Hopea tinctoria L. = *Symplocos tinctoria* (l.) L'Hér. (Rainfesque 1836; Darlington 1843).

CONVOLVULACEAE

Convolvulus battatas L. = *Ipomoea batatas* (L.) Lam.

"Convolvulus battatas—in fields—in New-Jersey and Delaware." (Rafinesque 1811a).

BORAGINACEAE

Cynoglossum officinale L.

"Cynoglossum officinale—common—in Delaware, Maryland, and N. Jersey, in roads and near houses." (Rafinesque 1811a).

SCROPHULARIACEAE

Antirrhinum cymbalaria = *Cymbalaria muralis* P. Gaertn., B. Mey. & J. Scherb.

"Antirrhinum cymbalaria, rare—in fields . . . in Delaware." (Rafinesque 1811a).

GENTIANACEAE

Bartonia tenella Muhl. ex Willd. = *B. virginica* (L.) Britton, Sterns & Poggenb. (Barton 1812).

Bartonia verna (Michx.) Raf. ex Barton (Barton 1812).

Chironea amoena Raf. = *Sabatia stellaris* Pursh

"Chironea amoena, graceful chironia; stem cylindrical, dichotomous, leaves-narrow-lanceolated, acute, flowers terminal, calix equalling in length the corolla, which is wheeled; grows on the sea-shores of Maryland, Delaware, and Jersey; the flowers are rose-colour, with a double star in the centre, the interior one yellow, the exterior one red. A variety has white flowers, with the same stars." (Rafinesque 1808b).

RUBIACEAE

Galium parviflorum Raf. = *G. concinnum* Torr. & A. Gray

"Galium parviflorum, small flowered galium; stems diffuse, angular, smooth; leaves verticillated 5 by 5, or 6 by 6, linear lanceolated, very acute, smooth; flowers paniculated, very minute and numerous, seeds smooth. In Newcastle county, Delaware. Very rare, flowers white, exceedingly small." (Rafinesque 1808b).

ASTERACEAE

Helianthus lanceolatus = *H. decapetalus* L. (Darlington 1843).

Jacobaea tomentosa = *Senecio tomentosus* Michx. (Darlington 1843).

Jacobaea lyrata = *S. aureus* L. (Darlington 1843).

Solidago pauciflora Raf. = ? depauperate *S. odora* Ait.?

"Solidago pauciflora; stem simple, smooth; leaves oblong-lanceolated, acute, entire, flowers 1–5 terminal. I have found it in Glocester county, New Jersey, and in Kent county, Delaware." (Rafinesque 1808b)

SUMMARY

1. Twelve species names listed above were never published by Rafinesque. These included: *Uniola paniculata, Zizania miliacea, Melanthium racemosum, Veratrum nigrum, Heliathus lanceolatus, Jacobaea tomentosa,* and *J. lyrata.*
2. The genus *Lennixylum,* with five species, was also never published by Rafinesque,

and so we must deduce its correct nomenclature from the meager evidence. *Lennixylum* (a.) is a member of the Juglandaceae, (b.) is sufficiently different from *Juglans* to warrant a separate genus, (c.) was described from the Piedmont of Delaware, and (d.) was apparently described primarily from the fruit. Rafinesque did publish *Hicoria amara* (Fl. Ludovic. 109. 1817), a synonym of *C. cordiformis*.

3. The report of *Astragalus canadensis* var. *canadensis* is noteworthy because there is no herbarium specimen of this taxon from DelMarVa (Duane Isley, pers. comm. 1988).
4. *Drosera filiformis* is also unvouchered from Delaware, although Fernald (1931), with no cited references or vouchers, included Cape Henlopen in his map of the range of *D. filiformis*. *Drosera filiformis* was figured by Rafinesque in a set of unpublished plates, as were *Burshia humilis* and *Hydnum barbatum* (Gerard 1885).
5. The publication of *Bartonia verna* by Barton antedates by a year the publication by Muhlenberg. This prior publication was first noted by Pennell (1926) and later by Little (1943), but was not cited in the most recent revision of *Bartonia* (Gillett 1959). Today *B. verna* ranges as far north as North Carolina (Gillett, 1959).
6. The *Florula Delawarica* may have included, at least, eight fungi, one lichen, one fern, two gymnosperms, 13 monocots, and 39 dicots from Delaware. The 55 vascular plants in this small reconstructed flora are distributed among 45 genera and 31 families.

THE RELEVANCE OF RAFINESQUE'S *FLORULA DELAWARICA* TODAY

For many botanists studying the composition of modern floras by examining historical records and collections, there is overwhelming evidence that our local floras have changed—sometimes drastically—over the past two centuries. This observation is sometimes difficult to appreciate fully; for, while we are quick to agree with Darwin on the dynamic nature of individual species, we often fall back to a pre-Darwinian position that local floras are rather static (floras comprised, albeit, of the admittedly dynamic individual species!).

The joy of finding a rare species existing today in exactly the same place it was reported 50 or 100 years ago on herbarium labels makes us realize that rarity is a common survival strategy successfully exploited by many species for long periods of time. At the same time, finding rare species "exactly where they are supposed to be" fosters our static view of nature. This view is self-reinforced by our limited lifetime views—and even more limited professional views—of any single flora.

Recent work in constructing lists of rare, threatened, and endangered species to support the conservation of biotic diversity brings us back to the dynamic nature of floras and makes us wish for a greater quantity of historic herbarium specimens with labels of higher informational quality.

Constantine S. Rafinesque seems to have had an unusual ability to spot important taxa as well as minor color variants. His preference for walking and his keen eye have given us an invaluable picture of a vanished Del-Mar-Va. In particular, the discovery of species which are now extirpated, such as *Astragalus canadensis* var. *canadensis, Drosera filiformis*, and *Bartonia verna*, indicate a flora in 1804 that was different from today.

Probably one of the most detrimental effects on the flora of Del-Mar-Va results from attempts to offset the gradual geological subsidence of the Del-Mar-Va Peninsula. The first extensive effort to drain Delaware dates back to the Culbreth Marsh Ditch Company in 1832 (Ratledge 1972–1973). Over 150 years of gradual drainage from ditching have affected a high number of rare, threatened, and endangered wetland species (Tucker et al. 1979; Naczi et al. 1986; Dill et al. 1987). Sadly, we have only recently realized the importance of freshwater wetlands.

The observations and collections of botanists such as Rafinesque provide us with baseline data from which to measure nearly two centuries of change. These works are priceless contributions to our understanding of floristic dynamics, the management of threatened habitats, and the conservation of biological diversity.

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Bartonia No. 55: 15–17, 1989

The Russulas of Delaware and Maryland's Eastern Shore[1]

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The mushrooms of the genus *Russula* are among the best known and most easily recognizable taxa of the Agaricales, but the individual species are difficult to determine due to morphological homogeneity within the genus. With few exceptions, the sporocarps have broadly convex pilei, straight non-tapering stipes, and brittle flesh. The genus is comprised primarily of obligate ectomycorrhizal species, whose pigment-rich basidiocarps constitute the most conspicuous element of the summer woodland mushroom flora in Delaware and Maryland's Eastern Shore. The genus is cosmopolitan in distribution and must be considered of some importance in forestry, at least in the temperate zone, because they form mycorrhizae with a large number of forest tree genera including; *Pinus, Picea, Abies, Larix, Pseudotsuga, Tsuga, Salix, Quercus*, and *Betula* (Singer 1986).

The pilei of the genus *Russula* are often vividly colored with cytochroic (cytoplasmic) and cystochroic (vacuolar) pigments usually confined to the cuticle and subcuticle. Pileus color may vary with age (mature pilei tend to exhibit lighter hues than young pilei of a given species) or with moisture (pilei of some species tend to ''wash out'') (Watson 1966). Still, pileus color is the most useful macroscopic character in determining species when considering fresh specimens. The presence or absence of epichroic pigments (discoloration due to injury) is a taxonomic criterion used in determining several species of *Russula*.

The senior author began intensive collection of the fungi of Delmarva in May of 1983 for inclusion in the Claude E. Phillips Herbarium (DOV). Special emphasis was placed on the genus *Russula* (Order Agaricales, Family Russulaceae). Regional herbaria with large holding of fungi, the U.S. National Fungus Collections (BPI) and the Academy of Natural Sciences of Philadelphia (PH) were surveyed. This paper reports on 8 species of the genus *Russula* commonly occurring in Delaware and Maryland's Eastern Shore. All descriptions are from fresh specimens, later deposited in DOV. Color terminology used in the description of pilei are given in accordance with Kornerup and Wanscher (1978). Spore deposit color is given in the terminology of Romagnesi (1967). General descriptive terms follow Snell and Dick (1971). Nomenclature and authorities follow Miller and Farr (1975).

1. **Russula albidula** Pk.

Found with mixed conifer-hardwoods. The pileus is 5 to 10 cm in diameter and convex. The cap is chalky white and is usually buried in leaf litter or soil. The gills are adnate; the spore print is pale white.

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[1] Contribution No. 13 from the Claude E. Phillips Herbarium.

Specimens examined: DOV: Sharptown (Wicomico Co.), MD, in mixed woods, J. L. Outten, 19 July 1984; Sharptown (Wicomico Co.), MD, in mixed woods, J. L. Outten, 12 Jul 1985; Dover (Kent Co.), DE, in well-drained woods at Del. St. College, M. Maciarello, 16 Jul 1983.

2. **Russula brevipes** Pk.

Found with many different species of *Pinus*. The pileus is 6 to 15 cm in diameter and depressed. The cap is chalky white. The gills are decurrent; the spore print is creamy white.

Specimens examined: DOV: Petersburg (Kent Co.), DE, in damp coniferous woods, M. Maciarello, 9 Oct 1983; Northeast (Cecil Co.), MD, in mixed woods, M. Maciarello, 19 July 1984; Marydel (Caroline Co.), MD, in coniferous woods, A. O. Tucker, 1 Sep 1986.

3. **Russula densifolia** (Secr.) Gill.

Found with hardwoods or mixed conifer-hardwoods. The pileus is 7 to 15 cm in diameter and convex. The flesh bruises red and then quickly darkens. The cap is chalky white to gray. The gills are slightly decurrent; the spore print is pale white.

Specimens examined: DOV: Sharptown (Wicomico Co.), MD, in coniferous woods, J. L. Outten, 19 Jul 1984; Sharptown (Wicomico Co.), MD, in coniferous woods, J. L. Outten, 12 Jul 1985; Brandywine Springs State Park (New Castle Co.), DE, in woods, D. M. Simmons, 16 Jun 1970; Bear (New Castle), DE, in mixed woods, M. Maciarello, 4 Jul 1983.

4. **Russula emetica** (Schaeff. ex Fr.) S. F. Gray

Found in damp conifer or mixed conifer-hardwood woodlands. The pileus is 4 to 10 cm in diameter and convex. The cap is signal red and fades in age or with wet weather. The gills are adnate; the spore print is yellow-white.

Specimens examined: DOV: Dover (Kent Co.), DE, in well-drained woods at Del. St. College, M. Maciarello, 8 Aug 1983; Princess Anne (Somerset Co.), MD, in mixed woods surrounding U of MD campus, M. Maciarello, 12 Aug 1984; Petersburg (Kent Co.), DE, in damp mixed woods, M. Maciarello, 10 Sep 1983; Dover (Kent Co.), DE, in well-drained woods at Del. St. College, E. Irwin-Larrimore, 7 Jul 1984.

5. **Russula fragilis** (Pers. ex Fr.) Fr.

Found with conifers or mixed conifer-hardwoods. The pileus is 2 to 7 cm in diameter with a depressed purplish red or olive-tinted center and lighter colored margin. The gills are adnexed; the spore print is yellowish white.

Specimens examined: DOV: Sharptown (Wicomico Co.), MD, in mixed woods, J. L. Outten, 19 Jul 1984; SW of Hudson Pond (Sussex Co.), DE, in sandy acid soil in coniferous woods, A. O. Tucker, 10 Aug 1983; (R. fallax) Dover (Kent Co.), DE, in well-drained woods at Del. St. College, E. Irwin-Larrimore, 8 Jul 1985; Sharptown (Wicomico Co.), MD, in mixed woods, J. L. Outten, 12 Jul 1983; Dover (Kent Co.), DE, in mixed woods at Del. St. College, M. Maciarello, 5 Aug 1986.

6. **Russula rubra** (Lamark ex Fr.) Fr.

Found with conifers, especially with species of *Pinus* and *Pseudotsuga*. The pileus is 6 to 8 cm in diameter and slightly depressed. The cap is tinted in the center with bright red. The gills are adnate; the spore print is yellowish-white. The flesh has a slightly sweet odor.

Specimens examined: PH: Naaman's Creek (Harveys Station) (New Castle Co.), DE, on earth in woods, Albert Commons, 15 Aug 1894; 2 miles W of Glasgow (New Castle Co.), DE, on earth in low woods, Albert Commons, 21 Aug 1894; Wilmington (New Castle Co.), DE, on earth in low woods, Albert Commons, 25

Aug 1894, DOV: Cardiff, New Castle (New Castle Co.), DE, in pine forest, pine woods, M. Maciarello, 12 Aug 1985.

7. **Russula virescens** (Schaeff. ex Zantedeschi) Fr.

Found with hardwoods or mixed hardwood-conifers. The pileus is 6 to 15 cm in diameter and sightly depressed. The cap is olive brown to gray-green with minute white cracks. The gills are adnate; the spore print is pale orange-yellow.

Specimens examined: PH: Naaman's Creek (Harveys Station) (New Castle Co.), DE, on earth in woods, Albert Commons, 15 Aug 1894. DOV: Dover (Kent Co.), DE, in leaf litter of hardwood forest at Del. St. College, M. Maciarello, 17 Jul 1984, Dover (Kent Co.), DE, in leaf litter of mixed woods at Del. St. College, M. Maciarello, 8 Jul 1985, Dover (Kent Co.), DE, in leaf litter of hardwood forest at Del. St. College, M. Maciarello, 8 Jul 1986; Northeast (Cecil Co.), MD, in mixed woods, M. Maciarello, 12 Jul 1985; Sharptown (Wicomico Co.), MD, in coniferous woods, J. L. Outten, 19 Jul 1984.

8. **Russula xerampilina** (Schaeff. ex Secr.) Fr.

Found with conifers. The pileus is 2 to 12 cm in diameter and slightly depressed. The cap is purplish-red. The stipe is tinted pink and hallow in age. The flesh has a distinct fish odor. The gills are adnate; the spore print is yellowish-white.

Specimens examined: PH: Wilmington (New Castle Co.), DE, on ground in open woods, Albert Commons, 15 Sep 1890. DOV: Petersburg (Kent Co.), DE, on ground under white pines, M. Maciarello, 10 Sep 1983; Trap Pond (Sussex Co.), DE, on ground under *Pinus taeda*, M. Maciarello, 12 Aug 1985; Newark (New Castle Co.), DE, on ground in evergreen woods, H. Ling, 25 Sep 1967.

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Intertidal Variants of *Bacopa rotundifolia* and *B. innominata* in the Chesapeake Bay Drainage

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In 1942, M. L. Fernald described *Bacopa simulans* and *B. stragula* from fresh tidal shores of rivers in the Chesapeake Bay Drainage. *Bacopa simulans* was based on two collections along the Chickahominy River, the first in 1921[1] and the second in 1941. *Bacopa stragula* was based on collections along the Chickahominy and Mattaponi rivers, and at Salisbury on the Delmarva Peninsula. *Bacopa simulans* has not been reported or collected along the Chickahominy River since 1941. However, in 1987, plants identifiable as this species were discovered by Mark T. Strong along the Potomac River in Stafford County, Virginia, and were still there in 1988. *Bacopa stragula* still occurs along the Chickahominy and Mattaponi rivers, and also is present along the Pamunkey River. No recent sightings or collections are known from the Delmarva Peninsula despite searches by numerous botanists (L. E. Morse pers. comm.)

As apparent Chesapeake Bay Drainage endemics, both of these *Bacopa* taxa have received attention from plant conservationists in the past two decades. In the Smithsonian Institution's 1974 study (USFWS 1975), *Bacopa stragula* was nominated for the official federal list of endangered species, while *B. simulans* was considered "probably extinct." The most recent *Federal Register* notice of review for plants (USFWS 1985) maintains both species as candidates for official listing. Both taxa are considered state-rare by the Virginia Natural Heritage Program, and globally rare by The Nature Conservancy, while *B. stragula* is also considered possibly extirpated by the Maryland Natural Heritage Program (L. E. Morse pers. comm.). With both taxa now known extant in Virginia, determination of these plants taxonomic status may affect the kind of protection given them there.

Bacopa simulans and *B. stragula* both resemble species outside of the Chesapeake Bay Drainage. *Bacopa simulans* resembles *B. rotundifolia* (Michx.) Wettst., which is widely distributed in the midwestern U.S., but also is known from North Carolina (Hotchkiss 1940) and is introduced in California (Barrett and Strother 1978). Outside of the U.S., it is known from Mexico, Argentina, and Paraquay (Barrett and Strother 1978), and is introduced in Japan (Togashi 10355, FSU). *Bacopa stragula* resembles *B. innominata* (Gómez-Maza) Alain, which is known from the Carolinas, Florida, the West Indies, and Panama (Pennell 1935). The purpose of this study, conducted at the request of the U.S. Fish and Wildlife Service, is to determine if Fernald's taxa described from tidal tributaries of the Chesapeake warrant taxonomic recognition when compared to taxa they resemble outside of the Chesapeake Bay Drainage.

In the following discussion, all plants from tidal tributaries of Chesapeake Bay are referred to by the names Fernald (1942) gave them. All plants from outside the Chesapeake Bay Drainage are referred to as *B. rotundifolia* or *B. innominata*. Most of these plants are from non-tidal habitats and none is known by me from tidal habitats comparable to those in the Chesapeake Bay Drainage.

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[1] Pennell (1935) treated the plants collected along the Chickahominy River in 1921 as *Macuillamia obovata* Raf. Rafinesque (1840) applied this name to plants from "Virginia in the River Potomac. and in Louisiana, ..." Rafinesque's description is not concise enough to know what the Potomac plants were with certainty. They could have been *B. simulans* or, as Fernald (1942) points out, *Gratiola virginiana*.

BACOPA ROTUNDIFOLIA AND *B. SIMULANS*

Characteristics used by Fernald (1942 and 1950) to distinguish *B. rotundifolia* and *B. simulans* are listed in Table 1. These can be summarized as follows: (1) stems and pedicels pubescent in *B. rotundifolia* and glabrous in *B. simulans*, (2) stems, leaves, and pedicels more succulent or fleshy in *B. simulans* than in *B. rotundifolia*, (3) stems,

TABLE 1. Characteristics of *Bacopa rotundifolia* and *B. simulans* according to Fernald (1942 and 1950).

	Bacopa rotundifolia	*Bacopa simulans*
Habit		
1942	coarser and prostrate	relatively small, decumbent to erect
1950	creeping, with elongate and lax branches up to 6 dm long, forming floating mats	stem decumbent and rooting at base or suberect, simple or sparsely branched, 0.5–2 dm high
Stems		
1942	stems copiously hirsute	stems glabrous
1950	terminally pubescent branches	stems succulent, glabrous
Leaves		
1942	leaves thin and clearly nerved, more rounded, larger ones 2–3.5 cm long and 1.5–2.7 cm broad	more opaque leaves only 1–2 cm long and 0.6–1.5 cm broad
1950	leaves thin, round-obovate to suborbicular, with subcuneately narrowed but clasping bases, clearly palmately many-nerved, the larger 2–3.5 cm long and 1.5–2.5 cm broad	leaves fleshy, round-obovate or elliptic, rounded above, obscurely palmate-nerved, 1–2 cm long and 6–15 mm broad
Pedicels		
1942	slender and pubescent pedicels 0.8–2 cm long	thick glabrous pedicels at most 11 mm long
1950	pedicels twice or thrice length of calyx [6–8 mm long], slender pubescent	thick pedicels finally divergent or reflexed and 5–11 mm long
Flowers		
1942	rather showy campanulate corolla 6–8 mm long, with wide spreading limb about as broad	insignificant corolla 4 mm long and 2 mm broad
1950	outer sepals ovate, 6–8 mm long, longer than broad; corolla exserted, campanulate, 6–8 mm long, the wide-spreading limb about as broad, white with yellow throat	1 or 2 in axils; outer sepals tightly appressed, broadly ovate, rounded above, 4–5.5 mm long; tubular corolla insignificant, whitish, 4 mm long, about 2 mm broad, 5 lobed, the lobes nearly equalling the tube and emarginate, the throat yellow; the 4 stamens included, the anthers dark purple
Fruit		
1950	capsule globose or subglobose, nearly equaling sepals	capsule ellipsoid, included

leaves, and pedicels longer and/or larger in *B. rotundifolia* than in *B. simulans,* and (4) flowers longer in *B. rotundifolia* (6–8 mm) than in *B. simulans* (4 mm).

Numerous localities for *B. rotundifolia* in southern Illinois and eastern Missouri[2] and the one known locality for *B. simulans* along the Potomac River were visited in 1988 to help determine how well these characteristics distinguish these taxa. Populations of *B. rotundifolia* in Illinois and Missouri were observed around or in bodies of water over a range extending from several meters inland from the water's edge to out in water about 1 meter deep. The following correlations were apparent from these observations: (1) plants in water are less pubescent than those on land, (2) plants in water have smaller leaves and shorter pedicels than those on land, (3) plants in water have smaller flowers and fruits, as well as fewer flowers, than those on land. Judging from these field observations and a survey of herbarium specimens (see Acknowledgments for herbaria consulted), pubescence in *B. rotundifolia* is variable, but usually there. However, one glabrous plant was found: a specimen (Demaree 5240, NY) from Imboden, Arkansas. The sizes and succulence of vegetative structures vary considerably in *B. rotundifolia* and do not distinguish it from *B. simulans*. Measurements of sepal lengths and fruit lengths of *B. rotundifolia* also overlap those of *B. simulans,* although no plants of *B. rotundifolia* were found in the field that had flower lengths as short as 4 mm (the longest measured for *B. simulans*). There are no apparent morphological differences in the flowers and fruits that distinguish *B. rotundifolia* and *B. simulans,* and seeds of both taxa are identical in size, shape, and surface morphology.

BACOPA INNOMINATA AND *B. STRAGULA*

Characteristics used by Fernald (1942) to distinguish *B. innominata*[3] and *B. stragula* are listed in Table 2. Seven localities for *B. stragula* along the Chickahominy, Pamunkey, and Mattaponi rivers in Virginia and one locality for *B. innominata* in a seep near the Savannah River in South Carolina[4] were visited during 1988 to help determine how well these characteristics distinguish these taxa. All plants of *B. stragula* observed

TABLE 2. Characteristics of *Bacopa innominata* (*cyclophylla*) and *B. stragula* according to Fernald (1942).

	Bacopa innominata	*Bacopa stragula*
Stems	branches closely but minutely pilose	glabrous branches
Leaves	thin-leaved, blades of the primary axes mostly 1–1.5 cm long	thick and opaque leaves, 5–10 mm long
Pedicels	up to 8 mm long and pubescent	3–6 mm long
Stamens	2	3 or 4

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[2] I was unable to relocate *Bacopa rotundifolia* in North Carolina where it is known from one collection made at Lake Mattamuskeet in 1929 (Hotchkiss and Ekvall 3742, US).

[3] Fernald used the name *Bacopa cyclophylla* for the plants discussed here as *B. innominata*.

[4] I was unable to relocate *B. innominata* in North Carolina where, according to records of the North Carolina Natural Heritage Program, it was last observed in 1956 along Rockyhock Creek in Chowan County.

in the field, as well as specimens in herbaria, were glabrous. Most specimens of *B. innominata* are pilose to some extent; however, two specimens, one from Cuba (Shafer 395, US) and one from Puerto Rico (Britton, Britton, and Brown 6771, US), are glabrous. Leaf sizes of *B. stragula* are well within the range for *B. innominata,* and there are no detectable differences in leaf thickness. Pedicel lengths overlap and stamen numbers are more variable than Fernald indicated: I observed 2 stamens in flowers of *B. stragula* from the Chickahominy River and 4 stamens are illustrated in a drawing by A. Mariolle on a herbarium sheet of *B. innominata* from Florida (Nash 1405, NY). No morphological differences are apparent in flowers and fruits of *B. innominata* and *B. stragula,* and seeds of both taxa are identical in size, shape, and surface morphology.

Flower length measurements of *B. stragula* in tidal habitats were 3 mm or less and no flowers were observed that were completely open. However, when plants from the Chickahominy River were placed in a container with a saturated substrate for a few days, the corolla limbs spread open and the stigmas and stamens were readily visible. The longest measurement of these flowers was 5 mm, but most were closer to 4 mm. They were indistinguishable from flowers of container-grown plants of *B. innominata* collected in South Carolina.

CONCLUSIONS

Other plant species that grow in both tidal and non-tidal habitats exhibit variation patterns similar to those of *B. rotundifolia-simulans* and *B. innominata-stragula. Lindernia dubia, Gratiola virginiana,* and *G. neglecta,* which also are members of the Scrophulariaceae along with *Bacopa,* are in this category (Ferren and Schuyler 1980). Plants of *Lindernia dubia* in tidal habitats have thicker leaves with lower length-width ratios, shorter and thicker pedicels, and less opened flowers than plants in non-tidal habitats. Similar variation occurs in the two species of *Gratiola,* but with *G. neglecta* also having variation in pubescence. Plants of *G. neglecta* in tidal habitats are less pubescent than plants in non-tidal habitats, and sometimes are glabrous in tidal habitats.

The level of variation observed between *B. rotundifolia* and *B. simulans* is comparable to the infraspecific variation in *Lindernia dubia, Gratiola virginiana,* and *G. neglecta.* The variation between *B. innominata* and *B. stragula* is also at this level. Although flower lengths of *B. simulans* are consistently shorter than those of *B. rotundi folia,* the differences are about what would be expected as a phenotypic response to tidal conditions. Flowers of *B. simulans* presumably would enlarge and open more when grown in non-tidal conditions as did those of container-grown plants of *B. stragula.* These and other characteristics that Fernald used to distinguish *B. simulans* from *B. rotundifolia* and *B. stragula* from *B. innominata* are differences that would be expected in the same species depending on whether it grew in tidal or non-tidal habitats. If something other than these expected differences were found, there might be some basis for recognizing *B. simulans* and *B. stragula* as species. Since this was not the case, plants described as *B. simulans* are here regarded as intertidal variants of *B. rotundifolia* and plants described as *B. stragula* as intertidal variants of *B. innominata.*

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Noteworthy Recent Collections from Blair County, Pennsylvania

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Following the publication of an initial update of the flora of Blair County (Kunsman and Keener 1986), my continued field work has resulted in a number of additional records. The following species are the most significant of these recent collections and were selected because of their rarity in Pennsylvania or rarity or infrequency in central Pennsylvania (Wherry, Fogg, and Wahl 1979). Of the twenty species listed, fifteen represent new records from Blair County (including one apparent state record), four represent a second Blair County record, and one represents a third Blair County record.

The nomenclature follows Kartesz and Kartesz (1980). Voucher specimens have been deposited in the Herbarium of The Pennsylvania State University (PAC). The classification status of the species in regard to infrequency in Pennsylvania is based on the Pennsylvania Natural Diversity Inventory's 1987 Plants of Special Concern in Pennsylvania (POSCIP) list issued by the Department of Environmental Resources of the Commonwealth of Pennsylvania. The author gratefully acknowledges the assistance of the following: Charles Bier, Kasia Fogarasi, C. S. Keener, A. E. Schuyler and Sue Thompson.

LIST OF SPECIES

Anthriscus sylvestris (L.) Hoffm., moist wooded roadside.

Arabis hirsuta (L.) Scop., wooded limestone ledge. "Tentatively Undetermined" on the POSCIP list; second record for the county.

Bouteloua curtipendula (Michx.) Torr., dry calcareous clearing. "Rare" on the POSCIP list; second record for the county.

Carex careyana Dewey, rich wooded calcareous slope. "Endangered" on the POSCIP list.

Carex eburnea Boott, dry limestone ledge. "Endangered" on the POSCIP list; second record for the county.

Carex jamesii Schwein., rocky limestone woods.

Carex prairea Dewey, calcareous marsh. "Tentatively Undetermined" on the POSCIP list.

Carex schweinitzii Schwein., calcareous marsh. "Threatened" on the POSCIP list; second record for the county.

Carex tetanica Schk., calcareous marsh. "Threatened" on the POSCIP list.

Chenopodium glaucum L., weed in flower bed.

Epilobium strictum Muhl., calcareous marsh. "Tentatively Undetermined" on the POSCIP list.

Geum rivale L., calcareous marsh.

Iva annua L., weedy roadside ditch. Apparently a new record for Pennsylvania.

Lathyrus ochroleucus Hook., rocky limestone woods. "Threatened" on the POSCIP list; third record for the county.

Najas minor All., submerged in shallow water of dam.

Ranunculus pensylvanicus L.f., marshy bottomland.
Rhamnus alnifolia L'Hér., calcareous marsh.
Ribes hirtellum Michx., calcareous marsh.
Strophostyles helvola (L.) Ell., weedy roadside.
Zannichellia palustris L., submerged in shallow water of stream.

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A Checklist of the Vascular Plants of Cumberland County, New Jersey

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The species included in this list are 37 pteridophytes, 10 gymnosperms, and 1293 angiosperms for a total of 1340. Distributional notes are based on Witmer Stone's *The Plants of Southern New Jersey, with Especial Reference to the Flora of the Pine Barrens* (1911) and field work by Gerry Moore (1983–1988). A species enclosed in square brackets is not native to New Jersey. All species listed herein have a voucher specimen either at Rutgers (CHRB), The Academy of Natural Sciences (PH), or Gerry Moore's private collection, except for *Passiflora incarnata* whose inclusion is based on sight records by Gerry Moore and Merle Cottrell. Nomenclature follows Kartesz and Kartesz (1980).

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PTERIDOPHYTES

ASPLENIACEAE: *Asplenium platyneuron,* frequent; *Athyrium filix-femina* v. *angustum,* historical; *Athyrium felix-femina* v. *asplenioides,* occasional; *Dryopteris cristata,* occasional; *Dryopteris intermedia,* occasional; *Dryopteris marginalis,* rare; *Dryopteris spinulosa,* rare; *Onoclea sensibilis,* common; *Polystichum acrostichoides,* rare; *Thelypteris hexagonoptera,* rare; *Thelypteris noveboracensis,* occasional; *Thelypteris palustris* v. *pubescens,* frequent; *Thelypteris simulata,* occasional.

BLECHNACEAE: *Woodwardia areolata,* common; *Woodwardia virginica,* common.

DENNSTAEDTIACEAE: *Dennstaedtia punctilobula,* frequent; *Pteridium aquilinum* v. *latiusculum,* common; *Pteridium aquilinum* v. *pseudocaudatum,* frequent.

EQUISETACEAE: *Equisetum arvense,* frequent.

ISOETACEAE: *Isoetes echinospora* ssp. *muricata* v. *muricata,* occasional; *Isoetes riparia,* occasional.

LYCOPODIACEAE: *Lycopodium alopecuroides,* occasional; *Lycopodium appressum,* occasional; *Lycopodium carolinianum,* rare; *Lycopodium clavatum* v. *clavatum,* rare; *Lycopodium dendroideum,* frequent; *Lycopodium digitatum,* frequent; *Lycopodium lucidulum,* rare; *Lycopodium obscurum,* frequent; *Lycopodium tristachyum,* historical.

OPHIOGLOSSACEAE: *Botrychium dissectum,* frequent; *Botrychium virginianum* v. *virginianum,* occasional; *Ophioglossum vulgatum* v. *pseudopodum,* rare; *Ophioglossum vulgatum* v. *pycnostichum,* historical.

OSMUNDACEAE: *Osmunda cinnamomea,* common; *Osmunda claytoniana,* rare; *Osmunda regalis* v. *spectabilis,* frequent.

POLYPODIACEAE: *Polypodium virginianum,* rare.

SCHIZAEACEAE: *Schizaea pusilla,* historical.

SELAGINELLACEAE: *Selaginella apoda,* occasional.

GYMNOSPERMS

CUPRESSACEAE: *Chamaecyparis thyoides,* frequent; *Juniperus virginiana,* common.

PINACEAE: [*Pinus banksiana*], rare; *Pinus echinata,* frequent; *Pinus rigida,* common; *Pinus serotina,* rare; *Pinus strobus,* occasional; *Pinus taeda,* rare; *Pinus virginiana,* common.

TAXODIACEAE: [*Taxodium distichum*], rare.

ANGIOSPERMS

ACANTHACEAE: *Ruellia caroliniensis,* historical.

ACERACEAE: *Acer negundo,* occasional; [*Acer platanoides*], occasional; *Acer rubrum* v. *rubrum,* frequent; *Acer rubrum* v. *trilobum,* common; *Acer saccharinum,* rare.

AGAVACEAE: [*Yucca filamentosa*], occasional.

AIZOACEAE: [*Mollugo verticillata*], common.

ALISMACEAE: *Alisma plantago-aquatica* v. *parviflorum,* frequent; *Sagittaria engelmanniana,* occasional; *Sagittaria graminea,* frequent; *Sagittaria latifolia,* common; *Sagittaria subulata,* rare.

AMARANTHACEAE: [*Amaranthus albus*], rare; *Amaranthus cannabinus,* common; [*Amaranthus hybridus*], common; [*Amaranthus retroflexus*], common; [*Amaranthus spinosus*], occasional.

ANACARDIACEAE: *Rhus copallina,* common; *Rhus glabra,* frequent; *Rhus typhina,* rare; *Toxicodendron radicans* ssp. *radicans,* common; *Toxicodendron toxicarium,* occasional; *Toxicodendron vernix,* occasional.

APIACEAE: *Angelica venenosa,* historical; [*Anthriscus caucalis*], rare; [*Apium graveolens* v. *dulce*], historical; *Cicuta maculata,* common; [*Conium maculatum*], occasional; *Cryptotaenia canadensis,* rare; [*Daucus carota*], common; *Eryngium aquaticum* v. *aquaticum,* historical; *Hydrocotyle americana,* rare; *Hydrocotyle umbellata,* frequent; *Hydrocotyle verticillata,* rare; *Lilaeopsis chinensis,* occasional; *Oxypolis rigidior,* frequent; [*Pastinaca sativa*], occasional; *Ptilimnium capillaceum,* frequent; *Sanicula canadensis,* frequent; *Sium suave,* common; [*Torilis japonica*], rare.

APOCYNACEAE: *Apocynum androsaemifolium,* common; *Apocynum cannabinum* v. *cannabinum,* common; *Apocynum* × *medium,* occasional; [*Vinca minor*], occasional.

AQUIFOLIACEAE: *Ilex glabra,* common; *Ilex laevigata,* frequent; *Ilex opaca,* common; *Ilex verticillata,* common.

ARACEAE: *Acorus calamus,* frequent; *Arisaema triphyllum* ssp. *pusillum,* occasional; *Arisaema triphyllum* ssp. *triphyllum,* frequent; *Orontium aquaticum,* occasional; *Peltandra virginica* ssp. *virginica,* common; *Symplocarpus foetidus,* frequent.

ARALIACEAE: *Aralia nudicaulis,* frequent; *Aralia spinosa,* occasional; *Panax trifolius,* rare.

ARISTOLOCHIACEAE: *Aristolochia serpentaria,* historical.

ASCLEPIADACEAE: *Asclepias amplexicaulis,* frequent; *Asclepias incarnata,* common; *Asclepias purpurascens,* occasional; *Asclepias rubra,* historical; *Asclepias syriaca,* common; *Asclepias tuberosa,* common; *Asclepias variegata,* historical; *Asclepias verticillata,* historical.

ASTERACEAE: [*Achillea millefolium*], common; *Ambrosia artemisiifolia,* common;

Ambrosia trifida v. *trifida,* occasional; *Anaphalis margaritacea,* frequent; *Antennaria neglecta,* common; *Antennaria plantaginifolia* v. *ambigens,* frequent; *Antennaria plantaginifolia* v. *arnoglossa,* frequent; *Antennaria plantaginifolia* v. *plantaginifolia,* frequent; [*Anthemis arvensis*], frequent; [*Anthemis cotula*], frequent; *Artemsia campestris* ssp. *caudata,* occasional; [*Artemsia ludoviciana*], historical; [*Artemsia pontica*], historical; *Aster concolor,* rare; *Aster dumosus,* common; *Aster gracilis,* frequent; *Aster infirmus,* occasional; *Aster laevis* v. *laevis,* occasional; *Aster lateriflorus,* frequent; *Aster linariifolius* v. *linariifolius,* common; *Aster nemoralis,* rare; *Aster novibelgii,* frequent; *Aster patens,* frequent; *Aster paternus,* common; *Aster pilosus,* common; *Aster puniceus* v. *puniceus,* frequent; *Aster simplex,* occasional; *Aster solidagineus,* frequent; *Aster spectabilis,* frequent; *Aster subulatus,* frequent; *Aster tenuifolius,* occasional; *Aster umbellatus,* rare; *Aster undulatus,* frequent; *Aster vimineus,* frequent; *Baccharis halimifolia,* common; *Bidens aristosa* v. *retrorsa,* occasional; *Bidens bidentoides,* rare; *Bidens bipinnata,* common; *Bidens cernua,* frequent; *Bidens connata,* common; *Bidens coronata,* common; *Bidens discoidea,* occasional; *Bidens frondosa,* frequent; *Bidens laevis,* common; *Bidens vulgata,* rare; *Boltonia asteroides* v. *asteroides,* historical; [*Carduus nutans*], occasional; [*Centaurea cyanus*], occasional; [*Centaurea maculosa*], frequent; [*Centaurea nigrescens*], occasional; [*Chondrilla juncea*], frequent; *Chrysopsis mariana,* common; [*Cichorium intybus*], common; [*Cirsium arvense*], frequent; *Cirsium discolor,* occasional; *Cirsium horridulum,* occasional; *Cirsium pumilum,* occasional; [*Cirsium vulgare*], occasional; *Conyza canadensis* v. *pusilla,* frequent; [*Coreopsis lanceolata*], rare; *Corepsis rosea,* rare; [*Crepis capillaris*], occasional; *Eclipta prostrata,* rare; *Erechtites hieracifolia,* occasional; *Erigeron annuus,* common; *Erigeron pulchellus,* rare; *Erigeron strigosus,* frequent; *Eupatorium album,* common; *Eupatorium aromaticum* v. *aromaticum,* historical; *Eupatorium coelestinum,* historical; *Eupatorium dubium,* occasional; *Eupatorium fistulosum,* occasional; *Eupatorium hyssopifolium,* common; *Eupatorium leucolepis* v. *leucolepis,* frequent; *Eupatorium maculatum,* common; *Eupatorium perfoliatum* v. *perfoliatum,* common; *Eupatorium purpureum* v. *purpureum,* rare; *Eupatorium resinosum,* rare; *Eupatorium rotundifolium* v. *ovatum,* frequent; *Eupatorium rotundifolium* v. *rotundifolium,* frequent; *Eupatorium rotundifolium* v. *saundersii,* frequent; *Eupatorium rugosum,* occasional; *Eupatorium sessilifolium* v. *sessilifolium,* historical; *Euthamia graminifolia* v. *graminifolia,* frequent; *Euthamia graminifolia* v. *nuttallii,* frequent; *Euthamia tenuifolia,* frequent; [*Galinsoga parviflora*], historial; [*Galinsoga quadriradiata*], rare; *Gnaphalium helleri* v. *micradenium,* historical; *Gnaphalium obtusifolium,* common; *Gnaphalium purpureum,* frequent; *Helenium autumnale,* occasional; [*Helenium flexuosum*], rare; *Helianthus angustifolius,* occasional; [*Helianathus annuus*], occasional; *Helianthus decapetalus,* historical; *Helianthus divaricatus,* frequent; *Helianthus giganteus,* occasional; [*Helianthus mollis*], rare; [*Helianthus petiolaris*], historical; [*Helianthus rigidus* ssp. rigidus], rare; *Helianthus strumosus,* occasional; [*Helianthus tuberosus*], rare; [*Heterotheca subaxillaris*], frequent; [*Hieracium aurantiacum*], occasional; [*Hieraclium caespitosum*], common; *Hieracium gronovii,* frequent; [*Hieracium lachenalii*], occasional; *Hieracium paniculatum,* occasional; [*Hieracium pilosella* v. *pilosella*], frequent; *Hieracium scabrum* v. *scabrum,* frequent; *Hieracium venosum,* common; [*Hypochoeris radicata*], frequent; *Iva frutescens* ssp. *oraria,* common; *Krigia biflora,* rare; *Krigia virginica,* occasional; *Lactuca biennis,* frequent; *Lactuca canadensis,* common; *Lactuca hirsuta,* rare; [*Lactuca sativa*], historical; [*Lactuca serriola*], occasional; [*Leucanthemum vulgare*], common; *Liatris* *graminifolia,* frequent; *Liatris spicata,* rare; [*Matricaria matricarioides*], occasional; *Mikania scandens,* occasional; *Pluchea odorata* v. *odorata,* occasional; *Pluchea odorata* v. *succulenta,* frequent; *Prenanthes alba,* historical; *Prenanthes autumnalis,* historical; *Prenanthes serpentaria,* occasional; *Prenanthes trifoliolata,* occasional; *Rudbeckia fulgida,* historical; [*Rudbeckia hirta* v. *pulcherrima*], rare; *Senecio aureus,* occasional; *Senecio obovatus,* rare; *Senecio tomentosus,* historical; [*Senecio vulgaris*], historical; *Solidago arguta* v. *arguta,* rare; *Solidago arguta* v. *boottii,* rare; *Solidago bicolor,* frequent; *Solidgo caesia,* occasional; *Solidago canadensis* v. *scabra,* occasional; *Solidago elliottii* v. *ascendens,* rare; *Solidago erecta,* occasional; *Solidago fistulosa,* occasional; *Solidago gigantea* v. *gigantea,* occasional; *Solidago juncea* v. *juncea,* rare; *Solidago nemoralis* v. *nemoralis,* common; *Solidago odora,* common; *Solidago puberula* v. *puberula,* rare; *Solidago rugosa* v. *aspera,* historical; *Solidago rugosa* v. *rugosa,* common; *Solidago sempervirens* v. *mexicana,* occasional; *Solidago sempervirens* v. *sempervirens,* common; [*Sonchus arvensis* ssp. *arvensis*], historical; [*Sonchus arvensis* ssp. *uliginosus*], historical; [*Sonchus asper*], occasional; [*Sonchus oleraceus*], common; [*Tanacetum vulgare*], occasional; [*Taraxacum laevigatum*], rare; [*Taraxacum officinale*], common; [*Tragopogon porrifolius*], occasional; [*Tragopogon pratensis*], occassional; [*Tussilago farfara*], rare; *Vernonia glauca,* historical; *Vernonia noveboracensis,* frequent; [*Xanthium strumarium* v. *canadense*], frequent; [*Xanthium strumarium* v. *glabratum*], common.

BALSAMINACEAE: *Impatiens capensis,* common.

BERBERIDACEAE: *Podophyllum peltatum,* occasional.

BETULACEAE: *Alnus incana* ssp. *rugosa,* rare; *Alnus serrulata,* common; *Betula nigra,* occasional; *Betula populifolia,* frequent; *Corylus americana,* occasional; *Ostrya virginiana,* rare.

BIGNONIACEAE: *Campsis radicans,* frequent; [*Catalpa bignonioides*], frequent; [*Paulownia tomentosa*], rare.

BORAGINACEAE: [*Buglossoides arvense*], frequent; [*Echium vulgare*], rare; *Hackelia virginiana,* occasional; *Myosotis laxa,* rare; [*Myosotis scorpioides*], historical; [*Myosotis stricta*], rare; *Myosotis verna,* occasional; *Onosmodium virginianum,* rare.

BRASSICACEAE: [*Arabidopsis thaliana*], common; *Arabis canadensis,* rare; *Arabis lyrata* v. *lyrata,* occasional; [*Barbarea verna*], common; [*Barbarea vulgaris*], frequent; [*Brassica juncea*], occasional; [*Brassica nigra*], common; [*Brassica rapa*], occasional; *Cakile edentula,* frequent; [*Camelina microcarpa*], occasional; [*Cardamine hirsuta*], rare; *Cardamine parviflora* ssp. *parviflora,* occasional; *Cardamine pensylvanica,* frequent; [*Conringia orientalis*], historical; *Dentaria laciniata* v. *laciniata,* rare; *Erophila verna,* common; [*Erysimum cheiranthoides*], occasional; [*Hesperis matronalis*], occasional; [*Isatis tinctoria*], rare; [*Lepidium campestre*], common; [*Lepidium densiflorum*], occasional; *Lepidium virginicum,* common; [*Nasturtium officinale*], rare; [*Raphanus raphanistrum*], occasional; *Rorippa palustris* ssp. *fernaldiana,* rare; [*Rorippa sylvestris*], occasional; [*Sinapis arvensis*], occasional; [*Sisymbrium altissimum*], rare; [*Sisymbrium officinale* v. *leiocarpum*], occasional; [*Thlaspi arvense*], frequent.

CACTACEAE: *Opuntia humifusa,* frequent.

CALLITRICHACEAE: *Callitriche heterophylla,* frequent.

CAMPANULACEAE: *Campanula aparinoides,* historical; [*Jasione montana*], rare; *Lobelia canbyi,* rare; *Lobelia cardinalis,* common; *Lobelia inflata,* frequent; *Lobelia* *nuttallii,* common; *Lobelia puberula* v. *puberula,* occasional; *Lobelia siphilitica,* historical; *Lobelia spicata,* rare; *Triodanis perfoliata* v. *perfoliata,* common.

CAPRIFOLIACEAE: *Diervilla lonicera,* historical; [*Lonicera japonica*], common; [*Lonicera maackii*], rare; [*Lonicera morrowii*], historical; *Lonicera sempervirens,* occasional; *Sambucus canadensis* v. *canadensis,* common; [*Symphoricarpos albus*], historical; [*Symphoricarpos orbiculatus*], occasional; *Triosetum perfoliatum,* occasional; *Viburnum acerifolium,* frequent; *Viburnum cassinoides,* occasional; *Viburnum dentatum,* frequent; *Viburnum nudum,* frequent; *Viburnum prunifolium,* occasional; *Viburnum recognitum,* occasional.

CARYOPHYLLACEAE: [*Agrostemma githago*], occasional; [*Arenaria serpyllifolia*], frequent; [*Cerastium fontanum* ssp. *triviale*], common; [*Cerastium glomeratum*], occasional; [*Cerastium semidecandrum*], occasional; [*Dianthus armeria*], common; [*Lychnis coronaria*], rare; *Minuartia caroliniana,* historical; *Paronychia canadensis,* rare; *Paronychia fastigiata,* occasional; *Sagina decumbens,* occasional; *Sagina procumbens,* occasional; [*Saponaria officinalis*], common; [*Scleranthus annuus*], common; *Silene antirrhina,* frequent; [*Silene armeria*], occasional; *Silene caroliniana,* occasional; [*Silene dichotoma*], rare; [*Silene dioica*], rare; [*Silene noctiflora*], occasional; [*Silene stellata*], occasional; [*Silene vulgaris*], common; [*Spergula arvensis*], frequent; *Spergularia marina,* frequent; [*Stellaria graminea*], occasional; *Stellaria longifolia,* occasional; [*Stellaria media*], common.

CELASTRACEAE: *Euonymus americanus,* occasional; *Euonymus atropurpureus,* rare.

CERATOPHYLLACEAE: *Ceratophyllum demersum,* frequent.

CHENOPODIACEAE: *Atriplex patula,* frequent; [*Bassia hirsuta*], occasional; [*Chenopodium album* v. *album*], common; [*Chenopodium ambrosioides*], common; *Chenopodium leptophyllum,* rare; [*Chenopodium missouriense*], historical; [*Chenopodium pumilio*], historical; [*Cycloloma atroplicifolium*], occasional; *Salicornia europaea,* frequent; *Salsola kali,* occasional; *Suaeda depressa* v. *depressa,* historical; *Suaeda linearis,* occasional.

CISTACEAE: *Helianthemum canadense,* common; *Helianthemum propinquum,* occasional; *Hudsonia ericoides,* frequent; *Hudsonia tomentosa* v. *intermedia,* occasional; *Hudsonia tomentosa* v. *tomentosa,* frequent; *Lechea minor,* frequent; *Lechea pulchella* v. *moniliformis,* frequent; *Lechea racemulosa,* common; *Lechea villosa,* common.

CLETHRACEAE: *Clethra alnifolia,* common.

CLUSIACEAE: *Hypericum adpressum,* occasional; *Hypericum boreale,* occasional; *Hypericum canadense,* common; *Hypericum densiflorum,* occasional; *Hypericum denticulatum,* occasional; *Hypericum dissimulatum,* occasional; *Hypericum gentianoides,* common; *Hypericum gymnanthum,* historical; *Hypericum mutilum,* common; [*Hypericum perforatum*], common; *Hypericum punctatum,* occasional; *Hypericum stans,* frequent; *Hypericum stragulum,* frequent; *Triadenum virginicum,* common.

COMMELINACEAE: [*Commelina communis*], frequent; [*Tradescantia virginiana*], occasional.

CONVOLVULACEAE: *Calystegia sepium* ssp. *sepium,* common; *Calystegia spithaema* ssp. *spithaema,* historical; [*Convolvulus arvensis*], occasional; *Cuscuta compacta,* common; *Cuscuta corylii,* historical; *Cuscuta gronovii,* common; *Cuscuta pentagona,* frequent; [*Ipomoea coccinea*], rare; [*Ipomoea nil*], occasional; *Ipomoea pandurata,* frequent.

CORNACEAE: *Cornus alternifolia,* rare; *Cornus amomum,* frequent; *Cornus florida,* common; *Cornus foemina* ssp. *racemosa,* rare.

CUCURBITACEAE: [*Cucumis melo*], historical; *Echinocystis lobata,* rare; *Sicyos angulatus,* occasional.

CYPERACEAE: *Bulbostylis capillaris,* common; *Carex abscondita,* occasional; *Carex alata,* occasional; *Carex albolutescens,* frequent; *Carex annectens,* frequent; *Carex artitecta,* occasional; *Carex atlantica* v. *atlantica,* frequent; *Carex atlantica* v. *incomperta,* rare; *Carex barrattii,* rare; *Carex blanda,* frequent; *Carex bullata,* common; *Carex canescens,* frequent; *Carex cephalophora,* rare; *Carex collinsii,* common; *Carex comosa,* frequent; *Carex complanata,* occasional; *Carex convoluta,* frequent; *Carex crinita* v. *crinita,* common; *Carex cristatella,* rare; *Carex digitalis,* occasional; *Carex emmonsii,* occasional; *Carex exilis,* frequent; *Carex flaccosperma* v. *flaccosperma,* occasional; *Carex flaccosperma* v. *glaucodea,* occasional; *Carex folliculata,* frequent; *Carex hirsutella,* frequent; *Carex hormathodes,* rare; *Carex howei,* occasional; *Carex intumescens,* common; *Carex lacustris,* rare; *Carex laevivaginata,* rare; *Carex lanuginosa,* rare; *Carex laxiculmis* v. *laxiculmis,* rare; *Carex laxiflora* v. *laxiflora,* occasional; *Carex longii,* occasional; *Carex lupulina,* occasional; *Carex lurida,* common; *Carex mesochorea,* historical; *Carex mitchelliana,* historical; *Carex molesta,* historical; *Carex muhlenbergii,* frequent; *Carex nigromarginata,* frequent; *Carex normalis,* historical; *Carex pensylvanica,* common; *Carex projecta,* historical; *Carex rosea,* frequent; *Carex rostrata* v. *utriculata,* historical; *Carex scoparia* v. *scoparia,* frequent; *Carex seorsa,* rare; *Carex silicea,* rare; *Carex stipata,* frequent; *Carex straminea,* rare; *Carex striatula,* historical; *Carex stricta* v. *stricta,* frequent; *Carex stricta* v. *strictior,* occasional; *Carex styloflexa,* rare; *Carex swanii,* frequent; *Carex tonsa,* frequent; *Carex tribuloides,* occasional; *Carex trisperma,* v. *billingsii,* occasional; *Carex typhina,* rare; *Carex umbellata,* common; *Carex venusta* v. *minor,* frequent; *Carex virescens,* historical; *Carex vulpinoidea,* frequent; *Carex walteriana* v. *brevis,* frequent; *Cladium mariscoides,* frequent; *Cyperus dentatus,* frequent; *Cyperus engelmannii,* rare; *Cyperus erythrorhizos,* frequent; *Cyperus esculentus* v. *esculentus,* frequent; *Cyperus filicinus,* frequent; *Cyperus filiculmis* v. *filiculmis,* historical; *Cyperus filiculmis* v. *macilentus,* occasional; *Cyperus flavescens* v. *poaeformis,* common; *Cyperus grayi,* frequent; *Cyperus odoratus* v. *odoratus,* rare; *Cyperus ovularis,* common; *Cyperus polystachyos* v. *texensis,* historical; *Cyperus retrorsus* v. *retrorsus,* occasional; *Cyperus rivularis,* common; *Cyperus strigosus,* frequent; *Dulichium arundinaceum,* common; *Eleocharis acicularis* v. *acicularis,* frequent; *Eleocharis engelmannii,* historical; *Eleocharis equisetoides,* historical; *Eleocharis fallax,* occasional; *Eleocharis melanocarpa,* historical; *Eleocharis microcarpa,* occasional; *Eleocharis obtusa* v. *obtusa,* common; *Eleocharis olivacea,* frequent; *Eleocharis parvula,* historical; *Eleocharis quadrangulata,* historical; *Eleocharis robbinsii,* occasional; *Eleocharis smallii,* occasional; *Eleocharis tenuis,* common; *Eleocharis tortilis,* historical; *Eleocharis tricostata,* occasional; *Eleocharis tuberculosa,* frequent; *Eriophorum tenellum,* historical; *Eriophorum virginicum,* occasional; *Fimbristylis autumnalis,* frequent; *Fimbristylis castanea,* rare; *Psilocarya nitens,* rare; *Psilocarya scirpoides,* rare; *Rhyncospora alba,* frequent; *Rhyncospora capitellata,* frequent; *Rhyncospora chalarocephala,* occasional; *Rhyncospora fusca,* frequent; *Rhyncospora gracilenta,* occasional; *Rhyncospora inundata,* historical; *Rhyncospora macrostachya* v. *macrostachya,* occasional; *Rhyncospora microcephala,* historical; *Rhyncospora pallida,* historical; *Rhyncospora torreyana,* rare; *Scirpus americanus,* frequent; *Scirpus cylindricus,* occasional;

Scirpus cyperinus, common; *Scirpus georgianus,* frequent; *Scirpus polyphyllus,* historical; *Scirpus pungens,* frequent; *Scirpus purshianus,* historical; *Scirpus robustus,* frequent; *Scirpus subterminalis,* occasional; *Scirpus tabernaemontanii,* frequent; *Scleria minor,* rare; *Scleria reticularis* v. *pubescens,* rare; *Scleria triglomerata,* frequent.

DIAPENSIACEAE: *Pyxidanthera barbulata,* rare.

DIOSCOREACEAE: *Dioscorea hirticaulis,* historical; *Dioscorea villosa* v. *villosa,* occasional.

DIPSACACEAE: [*Dipsacus fullonum*], frequent.

DROSERACEAE: *Drosera filiformis* v. *filiformis,* historical; *Drosera intermedia,* common; *Drosera rotundifolia* v. *rotundifolia,* frequent.

ELAEAGNACEAE: [*Elaeagnus umbellata* v. *parvifolia*], common.

ELATINACEAE: *Elatine americana,* occasional.

ERICACEAE: *Arctostaphylos uva-ursi,* historical; *Chamaedaphne calyculata,* common; *Chimaphila maculata,* common; *Chimaphila umbellata* v. *cisatlantica,* rare; *Epigaea repens,* common; *Gaultheria procumbens,* common; *Gaylussacia baccata,* common; *Gaylussacia dumosa,* frequent; *Gaylussacia frondosa,* common; *Kalmia angustifolia* v. *angustifolia,* common; *Kalmia latifolia,* common; *Leiophyllum buxifolium,* historical; *Leucothoe racemosa,* common; *Lyonia ligustrina* v. *ligustrina,* frequent; *Lyonia mariana,* common; *Monotropa hypopithys,* occasional; *Monotropa uniflora,* common; *Orthilia secunda,* historical; *Pyrola americana,* rare; *Pyrola chlorantha,* historical; *Pyrola elliptica,* rare; *Rhododendron atlanticum,* rare; *Rhododendron periclymenoides,* frequent; *Rhododendron viscosum,* common; *Vaccinium angustifolium,* occasional; *Vaccinium corymbosum,* common; *Vaccinium macrocarpon,* frequent; *Vaccinium pallidum,* common; *Vaccinium stamineum* v. *stamineum,* occasional.

ERIOCAULACEAE: *Eriocaulon compressium,* rare; *Eriocaulon decangulare,* rare; *Eriocaulon parkeri,* rare; *Eriocaulon septangulare,* occasional.

EUPHORBIACEAE: *Acalypha gracilens* ssp. *gracilens,* frequent; *Acalypha rhomboidea,* occasional; *Acalypha virginica,* frequent; *Chamaesyce maculata,* common; *Chamaesyce polygonifolia,* frequent; *Chamaesyce vermiculata,* historical; [*Croton glandulosis* v. *septentrionalis*], frequent; *Crotonopsis elliptica,* historical; *Euphorbia corollata* v. *corollata,* rare; [*Euphorbia cyparissias*], common; *Euphorbia ipecacuanhae,* common; [*Euphorbia marginata*], historical; [*Poinsettia dentata*], occasional; [*Ricinus communis*], historical.

FABACEAE: *Aeschynomene virginica,* rare; [*Albizia julibrissin*], frequent; *Amphicarpa bracteata,* frequent; *Apios americana* v. *americana,* frequent; *Baptisia tinctoria* v. *tinctoria,* common; *Cassia fasciculata,* common; *Cassia nictitans,* common; *Clitoria mariana,* rare; *Crotalaria sagittalis,* frequent; [*Cytisus scoparius*], rare; *Desmodium canadense,* occasional; *Desmodium ciliare* v. *ciliare,* occasional; *Desmodium glabellum,* frequent; *Desmodium laevigatum,* rare; *Desmodium marilandicum,* frequent; *Desmodium nudiflorum,* occasional; *Desmodium nuttallii,* historical; *Desmodium obtusum,* common; *Desmodium paniculatum* v. *paniculatum,* common; *Desmodium rotundifolium,* frequent; *Desmodium strictum,* rare; *Desmodium viridiflorum,* occasional; *Galactia regularis,* occasional; *Galactia volubilis,* historical; [*Gleditsia tricanthos*], occasional; [*Kummerowia stipulacia*], frequent; [*Kummerowia striata*], frequent; *Lathyrus japonicus* v. *glaber,* occasional; [*Lathyrus latifolius*], occasional; [*Lathyrus odoratus*], occasional; *Lathyrus palustris* v. *myrtifolius,* historical; *Lespedeza angustifolia,* frequent; [*Lespedeza bicolor*], occasional; *Lespedeza capitata,* common; [*Lespedeza cuneata*], frequent; *Lespedeza hirta* ssp. *hirta,* common; *Lespedeza intermedia,* common; *Lespedeza* × *longifolia,* occasional; *Lespedeza* × *nuttallii,* occasional; *Lespedeza procumbens,* occasional; *Lespedeza repens,* common; *Lespedeza stuevii,* rare; *Lespedeza violacea,* historical; *Lespedeza virginica,* common; [*Lotus corniculatus*], frequent; *Lupinus perennis* v. *perennis,* frequent; [*Medicago lupulina*], common; [*Medicago sativa*], frequent; [*Robinia hispida* v. *hispida*], occasional; [*Robinia pseudoacacia*], frequent; *Strophostyles helvola* v. *helvola,* frequent; *Strophostylos umbellata* v. *umbellata,* frequent; *Stylosanthes biflora,* historical; *Tephrosia virginiana,* frequent; [*Trifolium arvense*], common; [*Trifolium aureum*], common; [*Trifolium campestre*], common; [*Trifolium dubium*], occasional; [*Trifolium hybridum*], frequent; [*Trifolium incarnatum*], historical; [*Trifolium pratense*], common; [*Trifolium repens*], common; [*Vicia grandiflora*], occasional; [*Vicia hirsuta*], occasional; [*Vicia lathyroides*], occasional; [*Vicia sativa* ssp. *nigra*], frequent; [*Vicia sativa* ssp. *sativa*], common; [*Vicia villosa* ssp. *varia*], occasional; [*Vicia villosa* v. *villosa*], occasional; [*Wisteria floribunda*], rare; [*Wisteria frutescens*], occasional.

FAGACEAE: *Castanea dentata,* occasional; *Fagus grandifolia,* common; *Quercus alba,* common; *Quercus bicolor,* rare; *Quercus coccinea,* common; *Quercus falcata,* common; *Quercus* × *heterophylla,* occasional; *Quercus ilicifolia,* common; *Quercus imbricaria,* historical; *Quercus marilandica,* common; *Quercus michauxii,* rare; *Quercus montana,* common; *Quercus nigra,* rare; *Quercus palustris,* frequent; *Quercus phellos,* common; *Quercus prinoides,* common; *Quercus rubra* v. *borealis,* rare; *Quercus stellata,* common; *Quercus velutina,* common.

GENTIANACEAE: *Bartonia paniculata,* frequent; *Bartonia virginica,* frequent; *Gentiana autumnalis,* historical; *Gentiana saponaria,* rare; *Gentiana villosa,* historical; *Obolaria virginica,* historical; *Sabatia angularis,* rare; *Sabatia campanulata,* rare; *Sabatia difformis,* historical; *Sabatia stellaris,* occasional.

GERANIACEAE: [*Erodium cicutarium* ssp. *jacquinianum*], common; *Geranium carolinianum* v. *carolinianum,* common; [*Geranium columbinum*], occasional; *Geranium maculatum,* frequent; [*Geranium molle*], occasional; [*Geranium rotundifolium*], occasional.

HAEMODORACEAE: *Lachnanthes caroliana,* rare.

HALORAGIDACEAE: *Myriophyllum heterophyllum,* occasional; *Myriophyllum humile,* frequent; *Myriophyllum pinnatum,* historical; *Myriophyllum verticillatum,* historical; *Prosperpinaca palustris* v. *palustris,* occasional; *Prosperpinaca pectinata,* occasional.

HAMAMELIDACEAE: *Hamamelis virginiana,* occasional; *Liquidambar styraciflua,* common.

HIPPOCASTANACEAE: [*Aesculus hippocastanum*], rare.

HYDROCHARITACEAE: *Vallisneria americana,* frequent.

IRIDACEAE: [*Belamcanda chinensis*], occasional; *Iris prismatica* v. *prismatica,* frequent; [*Iris pseudacorus*], frequent; *Iris versicolor,* common; *Sisyrinchium angustifolium,* frequent; *Sisyrinchium arenicola,* historical; *Sisyrinchium atlanticum,* frequent.

JUGLANDACEAE: *Carya cordiformis,* occasional; *Carya glabra* v. *glabra,* common; *Carya glabra* v. *megacarpa,* occasional; *Carya ovalis,* occasional; *Carya ovata* v. *ovata,* occasional; *Carya pallida,* occasional; *Carya tomentosa,* frequent; *Juglans nigra,* frequent.

JUNCACEAE: *Juncus acuminatus,* common; *Juncus caesariensis,* historical; *Juncus canadensis* v. *canadensis,* common; *Juncus debilis,* rare; *Juncus dichotomus,* frequent; *Juncus effusus,* common; *Juncus marginatus* v. *marginatus,* frequent; *Juncus militaris,* occasional; *Juncus pelocarpus* v. *pelocarpus,* occasional; *Juncus platyphyllus,* occasional; *Juncus scirpoides,* frequent; *Juncus secundus,* occasional; *Juncus subcaudatus* v. *subcaudatus,* rare; *Juncus tenuis,* common; *Luzula bulbosa,* historical; *Luzula echinata,* occasional; *Luzula multiflora* ssp. *multiflora* v. *multiflora,* frequent.

LAMIACEAE: *Agastache nepetoides,* historical; *Agastache scrophulariifolia,* historical; *Collinsonia canadensis,* historical; [*Glechoma hederacea*], common; *Hedeoma pulegioides,* common; [*Lamium amplexicaule*], common; [*Leonurus cardiaca*], common; *Lycopus americanus,* common; *Lycopus amplectens,* frequent; [*Lycopus europaeus*], occasional; *Lycopus rubellus,* occasional; *Lycopus uniflorus,* rare; *Lycopus virginicus,* frequent; [*Marrubium vulgare*], historical; [*Mentha aquatica*], historical; *Mentha arvensis* ssp. *haplocalyx,* historical; [*Mentha* × *piperita*], occasional; [*Mentha spicata*], occasional; *Monarda didyma,* rare; *Monarda fistulosa* v. *mollis,* rare; *Monarda punctata,* frequent; [*Nepeta cataria*], occasional; [*Perilla frutescens* v. *frutescens*], rare; [*Prunella vulgaris*], common; *Pycnanthemum muticum,* rare; *Pycnanthemum setosum,* historical; *Pycnanthemum tenuifolium,* historical; *Pycnanthemum virginianum,* historical; *Salvia lyrata,* occasional; *Scutellaria elliptica,* occasional; *Scutellaria galericulata,* rare; *Scutellaria integrifolia,* frequent; *Scutellaria lateriflora,* frequent; *Stachys hyssopifolia,* historical; *Teucrium canadense,* occasional; *Trichostema dichotomum,* common; *Trichostema setaceum,* rare.

LARDIZABALACEAE: [*Akebia quinata*], rare.

LAURACEAE: *Lindera benzoin,* common; *Sassafras albidum,* common.

LEMNACEAE: *Lemna minor,* frequent; *Spirodela polyrhiza,* frequent.

LENTIBULARIACEAE: *Utricularia cornuta,* rare; *Utricularia fibrosa,* frequent; *Utricularia geminiscapa,* frequent; *Utricularia gibba,* rare; *Utricularia inflata,* occasional; *Utricularia juncea,* occasional; *Utricularia purpurea,* rare; *Utricularia radiata,* rare; *Utricularia subulata,* frequent; *Utricularia vulgaris,* occasional.

LILIACEAE: *Aletris farinosa,* occasional; *Allium canadense,* occasional; [*Allium vineale*], common; *Amianthium muscaetoxicum,* historical; [*Asparagus officinalis*], common; [*Convallaria majalis*], occasional; *Erythronium americanum,* rare; *Helonias bullata,* occasional; [*Hemerocallis fulva* v. *fulva*], common; *Hypoxis hirsuta,* frequent; *Lilium canadense* v. *canadense,* historical; [*Lilium lancifolium*], occasional; *Lilium superbum,* common; *Maianthemum canadense* v. *canadense,* frequent; *Medeola virginiana,* common; [*Muscari botryoides*], occasional; [*Narcissus pseudonarcissus*], occasional; [*Ornithogalum umbellatum*], frequent; *Polygonatum biflorum,* common; *Smilacina racemosa,* common; *Smilacina stellata,* occasional; *Uvularia perfoliata,* rare; *Uvularia sessilifolia,* frequent; *Veratrum viride,* occasional; *Xerophyllum asphodeloides,* rare; *Zigadenus leimanthoides,* historical.

LINACEAE: *Linum intercursum,* historical; *Linum medium* v. *texanum,* frequent; *Linum striatum,* frequent; [*Linum usitatissimum*], rare; *Linum virginanum,* rare.

LORANTHACEAE: *Phoradendron serotinum,* rare.

LYTHRACEAE: *Decodon verticillatus,* common; [*Lythrum alatum*], historical; *Lythrum lineare,* historical; *Rotala ramosior,* rare.

MAGNOLIACEAE: *Liriodendron tulipifera,* common; *Magnolia virginiana,* common.

MALVACEAE: [*Abutilon theophrasti*], frequent; [*Alcea rosea*], occasional; *Hibiscus moscheutos,* common; [*Hibiscus syriacus*], rare; [*Hibiscus trionum*], occasional; *Kosteletzkya virginica,* occasional; [*Malva neglecta*], common; [*Sida spinosa*], occasional.

MELASTOMATACEAE: *Rhexia mariana* v. *mariana,* common; *Rhexia virginica,* common.

MENISPERMACEAE: *Menispermum canadense,* occasional.

MENYANTHACEAE: *Nymphoides cordata,* rare.[1]

MORACEAE: [*Broussonetia papyrifera*], occasional; [*Cannabis sativa* ssp. *sativa*], rare; [*Maclura pomifera*], rare; [*Morus alba*], occasional; *Morus rubra,* frequent.

MYRICACEAE: *Comptonia peregrina,* common; *Myrica cerifera,* frequent; *Myrica heterophylla,* occasional; *Myrica pensylvanica,* common.

NAJADACEAE: *Najas flexilis,* occasional; *Najas gracillima,* historical.

NYCTAGINACEAE: [*Mirabilis linearis*], historical; [*Mirabilis nyctaginea*], rare.

NYMPHAEACEAE: *Brassenia schreberi,* occasional; [*Nelumbo nucifera*], rare; *Nuphar lutea* ssp. *pumila,* rare; *Nuphar lutea* ssp. *variegatum,* common; *Nymphaea odorata,* common.

NYSSACEAE: *Nyssa sylvatica* v. *sylvatica,* common.

OLEACEAE: *Chionanthus virginicus,* occasional; *Fraxinus americana* v. *americana,* rare; *Fraxinus americana* v. *biltmoreana,* historical; *Fraxinus nigra,* rare; *Fraxinus pennsylvanica,* rare; [*Ligustrum vulgare*], frequent; [*Syringa vulgaris*], occasional.

ONAGRACEAE: *Circaea lutetiana* ssp. *canadensis,* rare; *Epilobum angustifolium* ssp. *angustifolium,* historical; *Epilobum coloratum,* common; *Epilobum leptophyllum,* historical; *Ludwigia alternifolia,* common; *Ludwigia hirtella,* historical; *Lugwigia palustris,* common; *Lugwigia sphaerocarpa,* frequent; *Oenothera biennis,* common; *Oenothera fruticosa* ssp. *fruticosa,* common; [*Oenothera grandiflora*], historical; *Oenothera laciniata,* common; *Oenothera perennis,* occasional.

ORCHIDACEAE: *Arethusa bulbosa,* rare; *Calopogon tuberosus,* rare; *Corallorhiza odontorhiza,* historical; *Cypripedium acaule,* common; *Goodyera pubescens,* occasional; *Isotria verticillata,* historical; *Liparis lilifolia,* rare; *Liparis loeselii,* historical; *Listera australis,* rare; *Platanthera* × *bicolor,* historical; *Platanthera blephariglottis* v. *conspicua,* rare; *Platanthera ciliaris,* rare; *Platanthera clavellata,* occasional; *Platanthera cristata,* rare; *Platanthera lacera* v. *lacera,* occasional; *Pogonia ophioglossoides,* occasional; *Spiranthes cernua,* frequent; *Spiranthes lacera* v. *gracilis,* rare; *Spiranthes odorata,* historical; *Spiranthes tuberosa,* rare; *Spiranthes vernalis,* rare; *Tipularia discolor,* rare.

OROBANCHACEAE: *Epifagus virginiana,* frequent; [*Orobanche minor*], historical.

OXALIDACEAE: [*Oxalis acetosella*], historical; [*Oxalis corniculata* v. *atropurpurea*], historical; *Oxalis dillenii* ssp. *filipes,* common; *Oxalis europaea,* common; *Oxalis violacea* v. *violacea,* rare.

PAPAVERACEAE: [*Chelidonium majus*], frequent; *Sanguinaria canadensis,* rare.

PASSIFLORACEAE: [*Passiflora incarnata*], rare.

PHYTOLACCACEAE: *Phytolacca americana,* common.

PLANTAGINACEAE: [*Plantago aristata*], common; [*Plantago lanceolata* v. *lanceolata*], common; [*Plantago major* v. *major*], common; *Plantago rugelii,* frequent; *Plantago virginica,* common.

PLATANACEAE: *Platanus occidentalis,* occasional.

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[1] All *Nymphoides aquatica* specimens for Cumberland County are misidentifications of *Nymphoides cordata.*

PLUMBAGINACEAE: *Limonium carolinianum,* rare.

POACEAE: [*Agropyron repens*], common; *Agrostis altissima,* occasional; *Agrostis hiemalis,* frequent; *Agrostis perennans,* rare; *Agrostis scabra* v. *scabra,* historical; *Agrostis stolonifera,* common; [*Aira caryophyllea*], occasional; [*Airea praecox*], occasional; *Ammophila breviligulata,* common; *Amphicarpum purshii,* occasional; *Andropogon elliottii,* rare; *Andropogon gerardii* v. *gerardii,* rare; *Andropogon glomeratus,* common; *Andropogon virginicus,* common; [*Anthoxanthum odoratum*], frequent; *Aristida dichotoma,* common; *Aristida longespica,* v. *longespica,* occasional; *Aristida oligantha,* occasional; *Aristida tuberculosa,* occasional; *Aristida virgata,* historical; [*Arrhenatherum elatius*], frequent; [*Avena sativa*], rare; [*Bromus commutatus*], occasional; [*Bromus inermus*], occasional; [*Bromus japonicus*], occasional; [*Bromus tectorum*], common; *Calamagrostis canadensis,* frequent; *Calamagrostis cinnoides,* frequent; *Calamovilfa brevipilis,* historical; *Cenchrus longispinus,* common; *Cenchrus tribuloides,* frequent; *Chasmanthium laxum,* common; *Cinna arundinacea* v. *arundinacea,* frequent; [*Cynodon dactylon*], rare; [*Dactylis glomerata*], common; *Danthonia compressa,* rare; *Danthonia sericea,* occasional; *Danthonia spicata,* common; *Deschampsia flexuosa* v. *flexuosa,* frequent; *Dichanthelium acuminatum* v. *acuminatum,* common; *Dichanthelium acuminatum* v. *densiflorum,* common; *Dichanthelium acuminatum* v. *implicatum,* common; *Dichanthelium acuminatum* v. *villosum,* occasional; *Dichanthelium acuminatum* v. *wrightianum,* historical; *Dichanthelium boreale,* historical; *Dichanthelium boscii,* occasional; *Dichanthelium clandestinum,* common; *Dichanthelium commutatum,* frequent; *Dichanthelium depauperatum,* frequent; *Dichanthelium dichotomum* v. *dichotomum,* frequent; *Dichanthelium dichotomum* v. *ensifolium,* rare; *Dichanthelium dichotomum* v. *tenue,* historical; *Dichanthelium oligosanthes* v. *oligosanthes,* historical; *Dichanthelium ovale* v. *addisonii,* common; *Dichanthelium sabulorum* v. *thinium,* frequent; *Dichanthelium scabriusculum,* historical; *Dichanthelium scoparium,* frequent; *Dichanthelium sphaerocarpon* v. *isophyllum,* occasional; *Digitaria cognatum,* frequent; *Digitaria filiformis,* frequent; [*Digitaria ischaemum*], common; [*Digtaria sanguinalis*], common; *Diplachne maritima,* historical; *Distichlis spicata* v. *spicata,* common; [*Echinocloa crusgalli*], common; *Echinochloa muricata* v. *muricata,* frequent; *Echinochloa walteri,* frequent; [*Eleusine indica*], common; *Elymus virginicus,* occasional; *Eragrostis capillaris,* occasional; [*Eragrostis cilianensis*], common; [*Eragrostis minor*], occasional; *Eragrostis pectinacea,* common; [*Eragrostis pilosa* v. *pilosa*], frequent; *Eragrostis spectabilis,* common; *Erianthus giganteus,* occasional; [*Festuca elatior*], frequent; *Festuca obtusa,* rare; [*Festuca ovina*], occasional; *Festuca rubra,* occasional; *Glyceria acutiflora,* occasional; *Glyceria canadensis* v. *canadensis,* common; *Glyceria canadensis* v. *laxa,* historical; *Glyceria obtusa,* common; *Glyceria septentrionalis,* frequent; *Glyceria striata,* frequent; *Gymnopogon ambiguus,* rare; *Hierochloe odorata,* rare; [*Holcus lanatus*], common; *Hordeum jubatum,* occasional; *Leersia oryzoides,* common; *Leersia virginica,* occasional; *Muhlenbergia frondosa,* historical; *Muhlenbergia mexicana,* historical; *Muhlenbergia schreberi,* occasional; *Muhlenbergia sobolifera,* historical; *Muhlenbergia torreyana,* historical; *Muhlenbergia uniflora,* rare; *Panicum amarum* v. *amarulum,* occasional; *Panicum anceps,* rare; *Panicum capillare,* common; *Panicum dichotomiflorum,* frequent; *Panicum hemitomon,* rare; *Panicum philadelphicum,* occasional; *Panicum rigidulum,* frequent; *Panicum stipitatum,* occasional; *Panicum verrucosum,* common; *Panicum virgatum* v. *cubense,* frequent; *Panicum virgatum* v. *virgatum,* common; *Paspalum dissectum,* historical; *Paspalum laeve* v. *laeve,* frequent;

Paspalum setaceum v. *ciliatifolium,* frequent; *Paspalum setaceum* v. *psammophilum,* occasional; *Paspalum setaceum* v. *setaceum,* occasional; *Phalaris arundinacea,* occasional; [*Phalaris canariensis*], rare; [*Phleum pratense*], common; *Phragmites australis,* common; [*Poa annua* v. *annua*], common; *Poa palustris,* rare; [*Poa pratensis*], common; [*Poa trivialis*], occasional; *Puccinellia fasciculata,* historical; *Puccinellia fernaldii,* frequent; *Schizachyrium scoparium,* common; [*Setaria glauca*], common; *Setaria magna,* historical; [*Setaria viridis*], common; *Sorghastrum nutans,* frequent; [*Sorghum halepense*], occasional; *Spartina alterniflora,* common; *Spartina cynosuroides,* common; *Spartina patens,* common; *Spartina pectinata,* occasional; *Sphenopholis nitida,* historical; *Sphenopholis obtusata* v. *major,* frequent; *Sphenopholis obtusata* v. *obtusata,* occasional; *Sporobolus asper* v. *asper,* historical; *Sporobolus clandestinus,* historical; *Sporobolus vaginiflorus,* rare; *Stipa avenacea,* frequent; *Tridens flavus* v. *flavus,* common; *Tripsacum dactyloides,* common; [*Triticum aestivum*], historical; [*Vulpia myuros* v. *myuros*], frequent; *Vulpia octoflora,* occasional; [*Zea mays*], occasional; *Zizania aquatica* v. *aquatica,* common.

POLEMONIACEAE: [*Ipomopsis rubra*], rare; [*Phlox paniculata*], occasional; [*Phlox subulata*], rare.

POLYGALACEAE: *Polygala brevifolia,* rare; *Polygala cruciata,* frequent; *Polygala incarnata,* historical; *Polygala lutea,* frequent; *Polygala mariana,* rare; *Polygala nuttallii,* common; *Polygala polygama,* historical; *Polygala sanguinea,* rare; *Polygala verticillata,* frequent.

POLYGONACEAE: [*Fagopyrum esculentum*], rare; *Polygonella articulata,* common; *Polygonum amphibium* v. *stipulaceum,* occasional; *Polygonum arifolium,* common; *Polygonum aviculare* v. *aviculare,* common; [*Polygonum caespitosum* var. *longisetum*], occasional; *Polygonum careyi,* occasional; [*Polygonum convolvulus* v. *convolvulus*], common; [*Polygonum cuspidatum*], occasional; *Polygonum densiflorum,* historical; *Polygonum erectum,* frequent; *Polygonum hydropiperoides* v. *hydropiperoides,* frequent; *Polygonum lapathifolium,* occasional; *Polygonum opelousanum* v. *opelousanum,* historical; *Polygonum pensylvanicum,* common; [*Polygonum persicaria*], common; *Polygonum ramosissimum* v. *prolificum,* historical; *Polygonum ramosissimum* v. *ramosissimum,* occasional; *Polygonum scandens* v. *cristatum,* frequent; *Polygonum scandens* v. *scandens,* frequent; *Polygonum setaceum,* historical; *Polygonum tenue* v. *tenue,* frequent; *Polygonum virginianum,* rare; [*Rumex acetosella*], common; [*Rumex crispus*], common; [*Rumex obtusifolius*], common; *Rumex verticillatus,* occasional.

PONTEDERIACEAE: *Heteranthera reniformis,* rare; *Pontederia cordata* v. *lancifolia,* common.

PORTULACACEAE: *Claytonia virginica* v. *virginica,* occasional.

POTAMOGETONACEAE: *Potamogeton confervoides,* rare; *Potamogeton diversifolius,* frequent; *Potamogeton epihydrus,* common; *Potamogeton oakesianus,* rare; *Potamogeton pectinatus,* historical; *Potamogeton pulcher,* occasional; *Potamogeton spirillus,* rare.

PRIMULACEAE: [*Anagallis arvensis*], frequent; *Lysimachia ciliata,* rare; *Lysimachia hybrida,* historical; [*Lysimachia nummularia*], frequent; *Lysimachia × producta,* historical; *Lysimachia quadrifolia,* common; *Lysimachia terrestris,* frequent; *Samolus valerandi* ssp. *parviflorus,* frequent; *Trientalis borealis,* common.

RANUNCULACEAE: *Anemone quinquefolia,* occasional; *Anemone virginiana,* historical; *Aquilegia canadensis,* occasional; [*Aquilegia vulgaris*], historical; *Caltha pa-*

lustris v. *palustris,* occasional; *Clematis virginiana,* common; [*Consolida ambigua*], historical; *Hepatica nobilis* v. *obtusta,* rare; *Ranunculus abortivus* v. *abortivus,* rare; [*Ranunculus acris*], rare; [*Ranunculus bulbosus*], common; *Ranunculus hispidus,* rare; *Ranunculus recurvatus,* occasional; [*Ranunculus repens*], rare; [*Ranunculus sardous*], historical; *Ranunculus scleratus* v. *scleratus,* occasional; *Thalictrum pubescens* v. *pubescens,* common; *Thalictrum revolutum,* historical; *Thalictrum thalictroides,* historical.

RHAMNACEAE: *Ceanothus americanus* v. *americanus,* rare.

ROSACEAE: *Agrimonia parviflora,* occasional; *Agrimonia pubescens,* historical; *Agrimonia rostellata,* rare; *Amelanchier canadensis,* common; *Amelanchier obovalis,* occasional; *Amelanchier stolonifera,* rare; *Aronia arbutifolia,* common; *Aronia melanocarpa,* frequent; *Aronia prunifolia,* frequent; *Crataegus crus-galli,* occasional; *Crataegus intricata,* occasional; *Crataegus pedicellata,* rare; *Crataegus pruinosa,* occasional; *Crataegus uniflora,* common; [*Fragaria* × *ananassa*], occasional; *Fragaria virginiana,* common; *Geum canadense,* frequent; *Geum virginianum,* occasional; *Malus angustifolia,* rare; [*Malus sylvestris*], occasional; [*Potentilla argentea*], occasional; *Potentilla canadensis* v. *canadensis,* common; [*Pontentilla intermedia*], historical; [*Potentilla norvegica* v. *norvegica*], frequent; [*Potentilla recta*], frequent; *Potentilla simplex* v. *simplex,* frequent; *Prunus americana,* occasional; *Prunus angustifolia* v. *angustifolia,* historical; [*Prunus avium*], rare; [*Prunus cerasifera*], historical; [*Prunus cerasus*], occasional; *Prunus maritima,* frequent; [*Prunus munsoniana*], historical; [*Prunus persica*], occasional; *Prunus serotina,* common; [*Pyrus communis*], rare; *Rosa carolina,* frequent; [*Rosa eglanteria*], historical; [*Rosa gallica*], historical; [*Rosa multiflora*], common; [*Rosa odorata*], historical; *Rosa palustris,* common; *Rosa virginiana,* frequent; *Rubus cuneifolius,* common; *Rubus enslenii,* occasional; *Rubus flagellaris,* common; *Rubus frondosus,* rare; *Rubus hispidus,* common; *Rubus hypolasius,* historical; [*Rubus laciniatus*], occasional; *Rubus occidentalis,* rare; *Rubus pensilvanicus,* occasional; [*Spiraea* × *billiardii*], historical; *Spiraea latifolia,* rare; *Spiraea tomentosa,* common.

RUBIACEAE: *Cephalanthus occidentalis,* common; *Diodia teres* v. *teres,* common; *Galium aparine,* frequent; *Galium circaezans* v. *circaezans,* occasional; *Galium circaezans* v. *hypomalacum,* occasional; [*Galium mollugo*], historical; *Galium obtusum,* rare; *Galium pilosum* v. *pilosum,* occasional; *Galium pilosum* v. *puncticulosum,* occasional; *Galium tinctorium,* occasional; *Galium triflorum,* occasional; [*Galium verum*], historical; *Hedyotis caerulea,* rare; *Hedyotis uniflora* v. *uniflora,* rare; *Mitchella repens,* common; [*Sherardia arvensis*], rare.

SALICACEAE: [*Populus alba*], common; [*Populus* × *canescens*], rare; *Populus grandidentata,* occasional; *Populus heterophylla,* rare; [*Populus nigra*], rare; *Populus tremuloides,* rare; [*Salix alba*], frequent; [*Salix babylonica*], occasional; *Salix bebbiana* v. *bebbiana,* historical; *Salix discolor,* rare; *Salix fragilis,* rare; *Salix nigra,* common; [*Salix purpurea*], historical; [*Salix* × *rubens*], historical; *Salix sericea,* occasional; [*Salix viminalis*], historical.

SANTALACEAE: *Comandra umbellata* ssp. *umbellata,* common.

SARRACENIACEAE: *Sarracenia purpurea* ssp. *purpurea,* occasional; *Sarracenia purpurea* ssp. *venosa,* occasional.

SAURURACEAE: *Saururus cernuus,* historical.

SAXIFRAGACEAE: *Chrysosplenium americanum,* rare; *Heuchera americana* v. *americana,* rare; *Itea virginica,* frequent; [*Philadelphus coronarius*], historical; *Ribes* *hirtellum* v. *hirtellum,* historical; [*Ribes odoratum*], historical; *Ribes rotundifolium,* historical; [*Ribes rubrum* v. *alaskanum*], rare; *Saxifraga virginiensis* v. *virginiensis,* rare.

Scrophulariaceae: *Agalinis maritima* v. *maritima,* occasional; *Agalinus purpurea* v. *purpurea,* frequent; *Agalinus setacea,* occasional; *Agalinus virgata,* rare; *Aureolaria flava* v. *flava,* occasional; *Aureolaria pedicularia,* occasional; *Aureolaria virginica,* frequent; *Chelone glabra* v. *glabra,* common; *Gratiola aurea,* occasional; *Gratiola neglecta* v. *neglecta,* rare; *Gratiola pilosa,* historical; *Gratiola virginiana,* occasional; [*Kickxia elatine*], historical; *Linaria canadensis,* common; [*Linaria vulgaris*], frequent; *Lindernia dubia* v. *anagallidea,* frequent; *Lindernia dubia* v. *dubia,* frequent; *Melampyrum lineare* v. *latifolium,* occasional; *Melampyrum lineare* v. *pectinatum,* common; *Mimulus ringens,* occasional; *Pedicularis canadensis* ssp. *canadensis,* rare; *Penstemon laevigatus,* historical; *Schwalbea americana,* historical; *Scrophularia lanceolata,* historical; *Scrophularia marilandica,* rare; [*Verbascum blattaria*], common; [*Verbascum thaspus*], common; [*Veronica agrestis*], rare; [*Veronica arvensis*], common; [*Veronica hederifolia*], occasional; *Veronica officinalis* v. *officinalis,* common; *Veronica peregrina* v. *peregrina,* common; *Veronica peregrina* v. *xalapensis,* occasional; [*Veronica persica*], occasional; *Veronica serpyllifolia* v. *humifusa,* occasional; [*Veronica serpyllifolia* v. *serpyllifolia*], occasional.

Simaroubaceae: [*Ailanthus altissima*], frequent.

Smilacaceae: *Smilax glauca* v. *leurophylla,* common; *Smilax herbacea,* occasional; *Smilax laurifolia,* historical; *Smilax pseudo-china,* frequent; *Smilax pulverulenta,* occasional; *Smilax rotundifolia,* common.

Solanaceae: [*Datura stramonium*], frequent; [*Lycium barbarum*], historical; [*Lycopersicon esculentum*], rare; [*Petunia parviflora*], rare; [*Petunia violacea*], rare; *Physalis heterophylla* v. *heterophylla,* occasional; *Physalis subglabrata,* rare; *Physalis virginiana,* historical; *Solanum carolinense,* frequent; [*Solanum dulcamara* v. *dulcamara*], occasional; [*Solanum nigrum*], frequent.

Sparganiaceae: *Sparganium americanum,* common; *Sparganium androcladum,* frequent.

Tamaricaceae: [*Tamarix gallica*], rare.

Tiliaceae: *Tilia americana,* historical.

Typhaceae: *Typha angustifolia,* frequent; *Typha* × *glauca,* frequent; *Typha latifolia,* common.

Ulmaceae: *Celtis occidentalis,* frequent; *Ulmus americana,* rare; [*Ulmus pumila*], rare; *Ulmus rubra,* rare.

Urticaceae: *Boehmeria cylindrica* v. *drummondiana,* occasional; *Pilea pumila* v. *pumila,* occasional; [*Urtica dioica* ssp. *dioica*], frequent; [*Urtica dioica* ssp. *gracilis* v. *procera*], historical; [*Urtica urens*], rare.

Valerianaceae: [*Valerianella locusta*], occasional.

Verbenaceae: *Phryma leptostachya,* rare; *Verbena* × *engelmannii,* historical; *Verbena hastata,* frequent; *Verbena simplex,* occasional; *Verbena urticifolia,* frequent.

Violaceae: *Viola affinis,* occasional; [*Viola arvensis*], occasional; *Viola brittoniana* v. *brittoniana,* occasional; *Viola conspersa,* rare; *Viola hirsutula,* rare; *Viola lanceolata* ssp. *laceolata,* frequent; *Viola lanceolata* ssp. *vittata,* occasional; *Viola macloskeyi* ssp. *pallens,* occasional; *Viola obliqua,* frequent; *Viola pedata,* frequent; *Viola primulifolia* v. *primulifolia,* common; *Viola pubescens* v. *leiocarpa,* rare; *Viola* *rafinesquii,* occasional; *Viola sagittata* v. *sagittata,* occasional; *Viola sororia,* occasional; *Viola triloba* v. *triloba,* frequent.

VITACEAE: *Parthenocissus quinquefolia,* common; *Vitis aestivalis,* common; *Vitis labrusca,* occasional; *Vitis vulpina,* rare.

XYRIDACEAE: *Xyris difformis,* frequent; *Xyris smalliana,* rare; *Xyris torta,* occasional.

ZOSTERACEAE: *Ruppia maritima,* rare.

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Notes on Some Recently Rediscovered New Jersey Plant Species

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Since the publication of my last paper (Bartonia 52: 44–48) reporting the rediscovery of 11 plant species previously ranked by the New Jersey Natural Heritage Program as historical or extirpated, a number of additional species have been relocated. This paper discusses 12 of the more significant of these finds made during the 1986–1988 field seasons. General notes on habitat and distribution are largely from Fernald (1950) and Gleason & Cronquist (1963) and supplemented with information provided by the botanists of several state Heritage Programs. Statements on rarity are based on determinations made by the Heritage Programs and also on information gleaned from The Nature Conservancy's global database. Nomenclature follows Kartesz & Kartesz (1980). Voucher specimens for all species discussed will be deposited at Rutgers (CHRB), and additional duplicates at the New York Botanical Garden (NY) and The Academy of Natural Sciences (PH).

Schizachne purpurascens

This northern species reaches the southeastern limit of its range in KY and WV. South of NY, PA, and most of the New England states, the species is rare and occurs at isolated sites, mostly in the higher mountains. The only documented NJ occurrence is a single site near Branchville, Sussex County, where it was collected in 1935 by H. N. Moldenke (Moldenke 8528, NY). After a considerable search I located a single clump of 20–30 leafy shoots and several fruiting culms at this site on 26 May 1988. It was growing in an old growth mixed hardwood forest on the ledge of a north facing limestone cliff. Several other rare NJ plant taxa also occur here: *Taxus canadensis, Oryzopsis asperifola, Carex backii* (last collected here in 1936), *C. eburnea*, and *Clematis occidentalis*.

Britton (1889) lists the species (under *Avena striata* Michx.) in his Catalog based on C. F. Austin's statement that it occurs in rocky woods on the Palisades, Bergen County. Britton appends the entry with the note "Not recently collected and not seen by me from the State." Taylor (1915) mentions the species only in a footnote stating that it had been reported from within his Flora's range. Herbarium specimens substantiating Austin's report have not been located. Austin's specimens often lack precise locational information and some researchers are skeptical of some of his records (Montgomery 1981). However, a number of species (e.g. *Dicentra canadensis, D. eximia*) reported by Austin from various NJ locations, have been subsequently verified by other collectors at his reported sites.

Carex haydenii

Carex haydenii reaches the southern limit of its range on the Coastal Plain of DE (Tucker et al. 1979) and NJ. In NJ it has been collected historically from four definite localities in at least three different counties (Bergen, Mercer, and either Morris or Somerset) between 1904 and 1915. Britton (1889) lists single sites in Camden and Morris counties, both of which are apparently unvouchered by specimens. The Camden record was rejected by Taylor (1915); perhaps this was based on comments made by Stone (1911). Recent Morris and Sussex county records, reported in Hough (1983), are based on sight records made by Abraitys (1957–1983). One of Abraitys' sites, located near Dekays, Sussex County, was relocated on 8 June 1986 by Irv Black, Tom Halliwell, and me. The species grew in a very wet sedge meadow in full sunlight and was associated with two other rare NJ sedges, *C. buxbaumii* and C. *rostrata*. One week later, we located a new site for *Carex haydenii,* this time in Warren County, near Shuster Pond. Here, the species grew sparingly in semi-shade on the shore of a limestone sinkhole pond.

Carex oligocarpa

This species grows in rich, often calcareous woods and occurs throughout much of the eastern United States. Despite recent intensive searching of seemingly suitable habitat, *Carex oligocarpa* retains its rare status in NJ. Historically, it was collected from six locations in Hunterdon, Sussex, and Warren counties,[1] the most recent collection being 1919 (Mackenzie s.n., NY). Abraitys (1957–1983) reports two additional Hunterdon County sight records, both of which have been unsuccessfully searched in recent years. During June of 1988 I located two sites for this species in Sussex County, one north of Paulins Kill Lake and the second just north of Buckmire Pond. At both locations the species grew on the crest of a limestone ridge in dry, open woods. A total of seven clumps of plants were counted. Present at both sites was the morphologically similar *C. hitchcockiana*. In addition to glabrous sheaths, I found the reddish bases and the more lax habit of *C. oligocarpa* useful in separating it from *C. hitchcockiana* in the field.

Polygonum glaucum

Polygonum glaucum is restricted to maritime beaches along the Atlantic coast from MA south to GA. Apparently it was once more frequent, but it is now reported as rare and declining throughout a significant portion of its range (Alan Weakley pers. comm.). It is known to be secure only on islands off the coast of MA (Bruce Sorrie pers. comm.) and the shores of Long Island, where it is still locally frequent (Bob Zaremba pers. comm.). The species typically occurs on upper seabeaches, sand dunes, and along the margins of salt ponds. These habitats have been greatly impacted by both natural and human disturbances. The species is especially vulnerable to off road vehicle traffic, mechanical beach raking, and beach reclamation projects.

In NJ, *Polygonum glaucum* has been collected at about fifteen sites from Monmouth County south to the southern tip of Cape May.[2] All but four of these collections date from the mid to late 1800's. Despite much searching during 1987 only three plants were confirmed extant. Two plants were located at a heavily used beach in Belmar, Monmouth County (a historical location) and a single plant at Island Beach State Park, Ocean County. At the latter site, the plant was growing between tire ruts made by off road vehicles. Whether or not the species still persists at this site is not known.

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[1] The species is reported for Bergen County in Britton's Catalog (1889) but no substantiating specimens have been located. The Mercer and Somerset county records in Hough (1983) are based on misidentified specimens of *Carex amphibola* at CHRB.

[2] This species is occasionally introduced into waste ground farther inland. It has been collected on ballast in Camden County (Pollard s.n., NY) and Abraitys (1957–1983) reports it from fill along the NJ Turnpike in Middlesex County.

Ranunculus allegheniensis

Tom Halliwell found a single plant of this species on 2 May 1988 growing in rich woods on a limestone ridge near Springdale, Sussex County. I visited the site a few days later and after an intensive search located 37 additional plants growing in two nearby colonies. Also present was *R. abortivus*. These two species are very similar, but the hooked and longer beaked achenes of *R. allegheniensis* are conspicuous, even without close inspection. Prior to its rediscovery, *R. allegheniensis* was known from a few specimens collected at a single site by K. K. Mackenzie in 1920 (Mackenzie s.n., CHRB, NY). Mackenzie's site was also near Springdale but located about 1 mile northeast of the current site.

Geum vernum

The earliest NJ record for *Geum vernum* is several 1885 specimens collected from a Princeton roadside, Mercer County (Peters s.n., CHRB, NY, PH). It was collected along the South Branch of Rancocas Creek, near Vincentown, Burlington County, in 1914 (Long 9556, NY; 9783 GH, PH) and again in 1936 (Fogg 10259, PH). I collected it from this site on 20 May 1986. It was locally frequent and grew in open woods and thickets. Two new locations were discovered in 1988. The first was located along the Southwest Branch of Rancocas Creek near Kirbys Mill, approximately 3 miles southwest of Long's Vincentown locality.[3] Here it occurred scattered over a mile or more of rich floodplain woods, growing under *Betula nigra, Fagus grandifolia, Liriodendron tulipifera,* and *Acer negundo*. At the second site, located near Springdale, Sussex County, the species grew abundantly in moist woods and thickets over limestone.

Britton (1889, 1913) and Hough (1983) consider *Geum vernum* to be adventive in NJ, both apparently basing their assessment on Peters' Princeton specimens. One of Peters' specimens at CHRB has "Very rare. Western plant" noted on the label. The reported range of the species is southern Ontario, NY and VT, south to NC and TN, west to IA and KS—not a distribution that is accurately characterized as "western." Peters probably also used "Princeton" loosely in describing the collecting locality and it's doubtful it was collected from Princeton proper; possibly it came from nearby Rocky Hill. At PH there are specimens of *Obolaria virginica* collected in 1883 by Peters labeled "Rocky Hill, Princeton" and of *Aplectrum hyemale* collected in 1882 and 1885 labeled both "Rocky Hill, near Princeton" and "Princeton." Taylor (1915) accepted the Princeton record as a native occurrence noting that the species was "rare and highly localized." Taylor also reports the species near Brooklyn, NY, adding "probably there adventive."

Neither Fernald (1950) nor Gleason & Cronquist (1963) indicate that the species is adventive in the East. It is considered native in NY (Mitchell 1986) and PA (Wherry et al. 1979) where there are a number of scattered records for the southeastern part of the state. Based on an assessment of current NJ sites and the species' general distribution in the Northeast, I see no compelling argument to reject *Geum vernum* as a native species in NJ.

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[3] Ted Gordon (pers. comm.) has subsequently informed me that he is fairly certain that this species also occurs farther upstream, near Medford.

Desmodium sessilifolium

A colony of about 160 plants of this species was discovered in the Pine Barrens near Da Costa, Atlantic County, on 18 September 1987. The population was concentrated in a small area of a dry sandy field and grew in association with *Andropogon virginicus, Panicum virgatum, Eragrostis spectabilis, Comptonia peregrina, Quercus alba, Q. velutina, Prunus serotina, Rhus copallina, Diodia teres, Chrysopsis mariana, Eupatorium hyssopifolium, Solidago nemoralis, S. odorata,* and other species characteristic of successional habitats. The continued survival of this colony is doubtful, as much of the field has already been cleared for a planned commercial development.

Historically, the species has been collected from at least four different sites in this same general vicinity. The most recent of these is a 1945 collection from Crowleytown, Burlington County (Koster D15-80-1, PH).[4] The species is of predominantly midwestern affinities and is rare throughout most northern and eastern portions of its range.

Galactia volubilis

New Jersey's two species of *Galactia* are morphologically similar and differ chiefly in flower size and the degree of pubescence. Both are southern in their geographical affinities and both occur in dry, sandy thickets, open woods, and along roadsides. *Galactia regularis* is infrequent to local throughout much of NJ's Coastal Plain, while *Galactia volubilis* is rare having been documented from 9 sites in Cape May, Cumberland, and Ocean counties.[5] Herbarium specimens examined of *G. volubilis* were dated between 1898 (Ocean County) and 1933 (Cumberland County) and most had been collected at 5 sites on the southern tip of Cape May County. On 4 November 1988 I located several plants at a site on the lower Cape May peninsula, about 1 mile northwest of Cold Spring. The plants grew intricately entwined on herbs and low shrubs in a dry sandy thicket in a pine/oak woodland. It was the climbing habit that first attracted my attention, and although not diagnostically conclusive, it is a good field mark for the species, since according to the manuals, *G. regularis* is described as rarely climbing.

Onosmodium virginianum

The reported range of *Onosmodium virginianum* is FL and LA north to MA. The species is rare, and apparently declining throughout the northern portion of its range. It is considered extirpated in MA (Sorrie 1987), historical in DE, PA, and RI, and known from a few extant occurrences in CT, MD, NJ, and NY. A herbarium search at BK, CHRB, CU, GH, NY, and PH produced 74 NJ specimens collected from approximately 32 localities in 11 counties. Fourteen of these localities are represented by specimens collected between 1847 and 1900. Specimens from an additional 18 localities were collected after 1900 with the most recent being a 1941 Gloucester County collection (Long 56734, PH). All but 4 sites are on the Coastal Plain, with the greatest concentration in Camden (11), Burlington (4), and Gloucester (4) counties.

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[4] The 1980 Burlington record cited in Snyder & Vivan (1981) is an error based on my misidentification.

[5] The Burlington and Salem county records cited in Hough (1983) are based on misidentified specimens of *G. regularis* at CHRB.

The only NJ location currently known is a relocation of a 1932 site (Long 38679, PH) located about 1 mile north of Cumberland, Cumberland County. On 28 June 1987 I counted 23 clumps at this site all growing in a dry, sandy, open scrub oak thicket along an abandoned sand road.

Although the majority of NJ specimens lack any meaningful habitat description, the above description seems typical of many of the Coastal Plain specimens that have habitat information: "margin of dry sandy woods" (Long 6466, PH); "border of dry woods" (Long 21012, PH); "dry, sandy, pine and oak scrub" (Long 56734, PH); and "dry thickets" (Mackenzie 8358, NY). Habitats off the Coastal Plain have been described as "shaded, dry sandy alluvium" (Long 47743, PH) in the Piedmont and as a "limestone ridge" (Van Syckle, s.n. NY) in the Ridge and Valley. Most of these habitats appear to be successional or disturbance maintained communities. The apparent decline of *Onosmodium virginianum* may be due in part to a loss of open habitats through succession, or, as was suggested by several colleagues, fire suppression.

Veronica catenata

Veronica catenata is widespread throughout the United States, occurring in wetlands, chiefly calcareous, coast to coast. It also occurs in Canada and Eurasia. The distribution of the species in the northeastern United States is local, and it is considered rare in a number of these states. It has been collected at two sites in NJ, both in Warren County.[6] Specimens were collected "near Warrenville" (Wiertown on present day maps) in 1907 by C. S. Williamson (PH). The only additional information recorded on the labels is "in water." This is the only NJ record cited by Pennell (1935). On 29 July 1988 I collected *V. catenata* at a site near Blairstown, about 8 miles northwest of the Williamson location. It grew in full sun to semi-shade in the channel of a springfed brook meandering through a limestone seepage fen. It was locally frequent, and in places formed the dominant aquatic vegetation. Associated species included *Potamogeton foliosus, Nasturtium officinale,* and, on adjacent banks, *Selaginella apoda, Carex flava, Trollius laxus* ssp. *laxus, Parnassia glauca,* and *Lobelia kalmii.*

Veronica catenata is sometimes confused with the morphologically similar Eurasian introduction, *V. anagallis-aquatica.*[7] *Veronica catenata* differs in its narrower leaves (few to several times longer than wide); a looser, fewer flowered inflorescence; flowers white, pale blue, or pink; blunter sepals; and fruit capsules wider than long. Pennell

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[6] Abraitys (1957–1983) has a 1961 site record for Johnsonburg, Warren County. The only response I got from him when I pressed for more information was a rather noncommital shrug of the shoulders. The species is not listed for NJ by Hough (1983) despite that a large part of the more recent information cited in her publication is based on Abraitys' field notes, and that Abraitys also reviewed the manuscript. Whether in later years Abraitys second guessed his record, or its omission was an oversite, is not known, but I see no reason why *V. catenata* wouldn't occur at Johnsonburg, since much suitable habitat is present.

[7] *Veronica anagallis-aquatica* is also present at this site. It occurs sparingly along the same stream channel, about 0.25 mile downstream from *V. catenata,* growing on seepy banks in a wooded glade. The two species are known to hybridize (Heckard and Rubtzoff 1977), but I observed no intermediates at this site.

(1935), Fernald (1950), and Gleason (1952) stress in their keys that the fruit of *V. catenata* is "evidently" or "deeply" notched, but this is a somewhat variable characteristic (Arthur Cronquist pers. comm.). The NJ material I collected had fruit capsules varying (often on the same plant) from only slightly notched to more or less deeply notched, agreeing more closely with the broader description given by Gleason & Cronquist (1963). Measurements of leaves of the specimens collected ranged from 35 to 65 mm long and 4 to 7 mm wide and averaged 8 times longer than wide—exceeding the up to 5 times longer than wide ratio stated in Gleason & Cronquist (1963).

Valerianella radiata

Twentieth century collections of this predominantly southern species have been confined to a small area of southwestern Cape May County. Between 1909 and 1943 O. H. Brown located an indeterminate number (at least two) of sites in dry sandy woods approximately 2 miles west of Cold Spring. Much of this area was obliterated in the 1940's by the construction of the Intracoastal Waterway Canal. On 29 May 1987 I found 13 plants of this inconspicuous annual at what I take to be Brown's 1943 location "dry woodlands south of the canal" (Brown s.n., PH). They grew alongside a path through dry, sandy, open woods under a canopy of *Carya* sp., *Quercus falcata, Sassafras albidum, Cornus florida,* and *Rhododendron prinophyllum.* The ground was covered by a dense, nearly exclusive growth of *Lonicera japonica* (which now, unfortunately, is an all too common occurrence in open woodlands throughout much of NJ). Only four plants were located at this site in 1988. What impact the *Lonicera* is having on this population remains to be determined.

Vernonia glauca

Vernonia glauca is a southern species which reaches the northern limit of its range in southwestern New Jersey and adjacent southeastern PA (Wherry et al. 1979). Unlike our common species *Vernonia novaboracensis,* which typically occurs in open wetlands, *V. glauca* is characteristic of dry, often rich woods. Bayard Long, who collected specimens at 9 of the 10 known NJ locations, frequently described the habitat as "loamy wooded slope" (Long 17668, 23399, 27276, PH) and "edge of dry woods" (Long 34717, 34917, PH). The species was last collected by Long in 1935. After unsuccessfully searching many of Long's locations, a small population was located on 12 August 1988 at a site where it was last collected in 1923 (Long 26848, PH). Twenty-eight scattered plants were counted in a dryish *Viburnum dentatum* thicket on a wooded slope of a ravine located southwest of Mantua, Gloucester County. No buds or flowers were observed and most of the larger plants had been browsed, apparently by deer.

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Plants of Liberty State Park, New Jersey

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Liberty State Park is located in Jersey City, New Jersey, directly across the Hudson River from the southern tip of Manhattan. Ellis Island and Liberty Island are just offshore. As "Communipaw," this area was a major seaport and railroad terminal from the early nineteenth to the middle of the twentieth century. During the last half of the nineteenth century, ship's ballast (sand, earth, furnace slag, and other low-value but weighty materials carried by sailing vessels to ensure stability at sea), as well as garbage, ashes, and material dredged from the harbor was used to fill in low-lying salt marsh land here, to accommodate waterfront facilities. In around 1869, for example, the Central Railroad of New Jersey filled about 300 acres (121 ha) to a depth of about two feet above high tide (Brown 1879). Eventually, the shoreline was shifted as much as 4,000 feet from its original line, which was located roughly where the New Jesey Turnpike is today.

These "ballast dumps of Communipaw" were a productive plant hunting site for such late 19th-century botanists as Addison Brown, Joseph Schrenk, Nathaniel Lord Britton, William Van Sickle, W. H. Rudkin, and M. Ruger. Like Kaighn's Point in Camden (Smith 1867), Communipaw was an entry point into the U.S. for many, mostly European, plants, which were transported here as seeds in ballast or in bulk cargo. The *Preliminary Catalogue of the Plants of New Jersey* (Britton 1881) lists 140 species of plants, known from Communipaw and nearby Hoboken, that were not included in the 1880 edition of *Gray's Manual of Botany*. Most of the plants on Britton's list have scarcely been seen in New Jersey since his time; but the list does include some plants that have since spread widely, such as *Hypochaeris radicata* and *Lactuca serriola*. The list also includes a few plants, such as *Diplotaxis tenuifolia, Erysimum repandum,* and *Epilobium hirsutum,* that are present at Liberty State Park today, but still rather uncommon in New Jersey.

Railroad operations reached their peak here in the early 1900s; on a busy day, over 28,000 people might pass through the Jersey Central Passenger Terminal here at Communipaw Ferry. But the traffic diminished in the 1950's, with emergence of truck transportation as a preferred means of bulk transport. Passenger traffic slowed as commuter busses and private cars took advantage of bridges and tunnels built in the 1930's and 1940's. Pier facilities became obsolete or unnecessary as railroad-related commerial and industrial activities in the region declined. The State of New Jersey acquired the land, in increments, between 1970 and 1975. One of the first projects undertaken by the State of New Jersey was a systematic clearing of railroad tracks, dumps, abandoned industrial buildings, and the like, which incidentally denuded the site of much of its vegetation. Aerial photos, taken after the cleanup, show little green. The Park was officially dedicated in 1976.

As might be expected from the above history, most of the Park today is undergoing secondary succession. Old fields are dominated by such genera as *Solidago, Eupatorium,* and *Artemisia*. There are some natural hedgerows and thickets of such pioneer trees as *Prunus serotina, Betula populifolia, Populus deltoides,* and *Ailanthus altis-*

sima along with shrubs like *Rhus copallina, Rhus typhina,* and *Polygonum cuspidatum.* The site is generally level and dry, but there are a few wet ditches and seasonally wet swales. Soils are variable, if artificial; but where the park has not been "reclaimed" and landscaped, much of the surface soil is still the cinder ballast of the railroad beds. There is a saltmarsh of about forty acres (16 ha) that has been designated as a natural area; a buffer zone around it has been planted to species such as *Pinus thunbergii, Rosa rugosa, Elaeagnus umbellata, Elaeagnus angustifolia,* and *Prunus maritima.* About 300 acres (121 ha) of the park are developed as lawns, picnic areas, and parking areas. The total area of the park is 1100 acres (445 ha).

List of Liberty State Park Vascular Plants

The following list was compiled from observations made by me on October 6, October 28, and December 4, 1987; and April 11, May 2, June 2, August 2, and September 21, 1988; by Naomi Dicker, Alice Belling, and Dirk Burhans on July 3, 8, and 15, 1988; and by members of the Torrey Botanical Club on September 3, 1988; and from observations of the park's flora made by Deborah Campbell, park naturalist, in 1985. Unconfirmed 1985 observations are followed by the notation "1985." Scientific names used in this list are from Kartesz & Kartesz (1980); where these names differ from those in Fernald (1950), the Fernald names are in parentheses after the Kartesz names. Plants not native to North America are enclosed in brackets. The list does not include obviously planted species.

Aceraceae: *Acer negundo, rubrum, saccharinum.*

Agavaceae: *Yucca filamentosa.*

Aizoaceae: *Mollugo verticillata.*

Alismataceae: *Alisma plantago-aquatica* var. *parviflorum (A. subcordatum); Sagittaria latifolia.*

Amaranthaceae: *Amaranthus albus, cannabinus (Acnida cannabina), [retroflexus]; Froehlichia gracilis.*

Anacardiaceae: *Rhus copallina, glabra, typhina; Toxicodendron radicans.*

Apiaceae: *[Daucus carota]; [Pastinaca sativa].*

Apocynaceae: *Apocynum cannabinum.*

Araliaceae: *Aralia hispida.*

Asclepiadaceae: *Asclepias syriaca.*

Aspleniaceae: *Onoclea sensibilis; Thelypteris palustris.*

Asteraceae: *[Achillea millefolium]; Ambrosia artemisiifolia; Anaphalis margaritacea (1985); [Anthemis arvensis, cotula]; [Arctium minus]; [Artemisia annua, vulgaris]; Aster novae-angliae, pilosus, simplex, subulatus, vimineus; Baccharis halimifolia; Bidens connata, frondosa, polylepis; [Centauria maculosa, nigrescens (vochinensis)]; [Cichorium intybus]; [Cirsium arvense, vulgare]; Conyza canadensis (Erigeron canadensis); Coreopsis lanceolata (1985); [Dittrichia graveolens]; Erechtites hieracifolia; Erigeron annuus, philadelphicus; Eupatorium altissimum, dubium, hyssopifolium, rotundifolium (pilosum), rugosum, serotinum; Euthamia graminifolia (Solidago graminifolia); [Galinsoga quadriradiata (ciliata)]; Gnaphalium obtusifolium; Helianthus annuus; Heterotheca subaxillaris; [Hieracium pilosella, sabaudum, caespitosum (pratense)]; Hypochaeris radicata; Iva frutescens; [Lactuca serriola (scariola)]; [Leucanthemum vulgare (Chrysanthemum leucanthemum)]; Pluchea odorata (purpurascens); [Rudbeckia hirta (serotina)]; [Senecio vulgaris]; Solidago canadensis, juncea, nemoralis, odora (1985), rugosa, sempervirens; [Sonchus oleraceus]; [Taraxacum officinalis]; [Xanthium strumarium].*

Balsaminaceae: *Impatiens capensis (1985).*

Betulaceae: *Betula populifolia.*

Boraginaceae: *[Echium vulgare].*

Brassicaceae: *[Alliaria petiolata (officinalis)]; [Arabidopsis thaliana]; [Barbarea vulgaris]; [Brassica rapa (campestris)]; Cakile edentula; [Capsella bursa-pastoris]; [Diplotaxis tenuifolia]; [Erophila verna (Draba verna)]; [Erysimum repandum]; [Lepidium campestre]; Raphanus raphanistrum; Rorippa palustris (islandica); [Sisymbrium altissimum].*

Campanulaceae: *Lobelia inflata; Triodanis perfoliata (Specularia perfoliata).*

Cannabinaceae: *[Humulus japonicus].*

Capparidaceae: *Polanisia dodecandra (graveolens).*

Caprifoliaceae: *[Lonicera japonica]; Sambucus canadensis.*

Caryophyllaceae: *[Arenaria serpyllifolia]; [Cerastium fontanum vulgatum)]; [Dianthus armeria]; [Saponaria officinalis]; [Scleranthus annuus]; [Silene alba (Lychnis alba)]; antirrhina, [vulgaris (cucubalus)]; Spergularia marina; [Stellaria media].*

Celastraceae: *[Celastrus orbiculatus].*

Chenopodiaceae: *Atriplex patula; [Bassia hyssopifolia]; [Chenopodium album], [ambrosioides], [botrys]; Cycloloma atriplicifolium; Salicornia europaea; Salsola kali; Suaeda linearis.*

Clusiaceae: *Hypericum gentianoides, mutilum, [perforatum].*

Commelinaceae: *[Commelina communis]; Tradescantia virginiana.*

Convolvulaceae: *Calystegia sepium (Convolvulus sepium); Convolvulus arvensis; Cuscuta gronovii; [Ipomoaea nil (hederacea)].*

Cyperaceae: *Bulbostylis capillaris; Carex annectens, hormathodes, stipata, vulpinoidea; Cyperus esculentus, filicinus, grayi, rivularis, strigosus; Eleocharis obtusa, palustris, parvula; Scirpus americanus (olneyi), cyperinus, pungens (americanus).*

Dipsacaceae: *[Dipsacus fullonum (sylvestris)].*

Elaeagnaceae: *[Elaeagnus umbellata].*

Equisetaceae: *Equisetum arvense.*

Euphorbiaceae: *Acalypha rhomboidea; Chamaesyce supina (Euphorbia supina); Chamaesyce nutans (Euphorbia maculata); [Euphorbia esula].*

Fabaceae: *Cassia fasciculata; [Coronilla varia]; [Lathyrus latifolius]; Lespedeza repens; [Lotus corniculatus]; [Medicago lupulina]; [Melilotus alba]; [M. officinalis]; Robinia pseudoacacia; [Trifolium arvense], [dubium], [hybridum], [pratense], [campestre (procumbens)], [repens].*

Fagaceae: *Quercus velutina.*

Geraniaceae: *Geranium carolinianum.*

Gentianaceae: *[Centaurium pulchellum]; Sabatia stellaris (1985).*

Hamamelidaceae: *Liquidambar styraciflua.*

Iridaceae: *Sisyrinchium atlanticum.*

Juncaceae: *Juncus acuminatus, effusus, gerardii, tenuis, torreyi.*

Lamiaceae: *[Glechoma hederacea]; Hedeoma pulegioides; [Lamium amplexicaule], [purpureum]; [Leonurus cardiaca]; Lycopus americanus, [europaeus], uniflorus; [Nepeta cataria]; [Prunella vulgaris]; Trichostema dichotomum.*

Lemnaceae: *Lemna minor.*

Liliaceae: *[Hemerocallis fulva].*

Lythraceae: *[Lythrum salicaria].*

Malvaceae: *[Abutilon theophrasti]; Hibiscus moscheutos, [trionum]; [Malva neglecta].*

Moraceae: *[Morus alba].*

Myricaceae: *Myrica pensylvanica.*

Nyctaginaceae: *Mirabilis nyctaginea.*

Oleaceae: *Fraxinus americana.*

Onagraceae: *Epilobium coloratum, [hirsutum]; Ludwigia palustris; Oenothera biennus.*

Orchidaceae: *Spiranthes cernua.*

Osmundaceae: *Osmunda cinnamomea.*

Oxalidaceae: *[Oxalis stricta].*

Phytolaccaceae: *Phytolacca americana.*

Plantaginaceae: *Plantago aristata, [lanceolata], [major].*

Poaceae: *[Agrostis stolonifera (alba)], hiemalis; Ammophila breviligulata; Andropogon virginicus; [Anthoxanthum odoratum]; [Apera interrupta (Agrostis interrupta)]; Aristida dichotoma, A. oligantha; [Bromus japonicus], [tectorum]; [Calamagrostis epigeios]; Cenchrus longispinus; [Dactylis glomerata]; Dichanthelium acuminatum (Panicum lanuginosum); [Digitaria ischaemum], [sanguinalis]; Distichlis spicata; [Echinochloa crus-galli], walteri; [Eleusine indica]; [Eragrostis curvula], [cilianensis (megastachya)], pectinacea, spectabilis; [Festuca arundinacea], ovina, [rubra]; [Holcus lanatus]; Hordeum jubatum; [Lolium multiflorum], [perenne]; Panicum capillare, dichotomiflorum, verrucosum, virgatum; Phragmites australis (communis); [Poa annua], [pratensis], [trivialis]; Schizachyrium scoparium (Andropogon scoparius); [Se-*

taria faberi], [glauca], [viridis]; Spartina alterniflora, patens; Sporobolus vaginiflorus; Tridens flavus (Triodia flava); [Vulpia myuros].

POLYGONACEAE: *Polygonella articulata; [Polygonum aviculare], [cespitosum], [cuspidatum], hydropiperoides, lapathifolium, pensylvanicum, [persicaria], punctatum, tenue, scandens; [Rumex acetosella], [crispus], [obtusifolius], [patientia].*

PORTULACACEAE: *[Portulaca grandiflora], [oleracea].*

PRIMULACEAE: *Lysimachia ciliata (1985).*

ROSACEAE: *Fragaria virginiana; [Potentilla argentea], [norvegica], [recta], simplex; Prunus pensylvanica, serotina; [Malus pumila (Pyrus malus)]; [Rosa multiflora]; [Rubus laciniatus], ostryifolius, strigosus; Spiraea tomentosa.*

RUBIACEAE: *Diodea teres; [Galium mollugo].*

SALICACEAE: *[Populus alba], deltoides, grandidentata, tremuloides; [Salix babylonica], [discolor], nigra.*

SCROPHULARIACEAE: *Linaria canadensis, [vulgaris]; Lindernia dubia; [Paulownia tomentosa]; Penstemon digitalis (1985); Verbascum blattaria, [phlomoides], [thapsus]; [Veronica arvensis], [peregrina].*

SIMARUBACEAE: *[Ailanthus altissima].*

SOLANACEAE: *[Datura stramonium]; [Lycopersicon esculentum]; [Petunia violacea]; Physalis pumila (longifolia); Solanum carolinense, dulcamara, [nigrum].*

TAXODIACEAE: *Taxodium distichum.*

TYPHACEAE: *Typha angustifolia, latifolia.*

ULMACEAE: *Celtis occidentalis.*

URTICACEAE: *[Urtica dioica].*

VERBENACEAE: *Verbena bracteata, hastata, stricta, urticifolia.*

VIOLACEAE: *[Viola arvensis].*

VITACEAE: *[Ampelopsis brevipedunculata]; Parthenocissus quinquefolia; Vitis vulpina.*

PLANTS OF SPECIAL INTEREST

The following plants are of unusual occurrence in New Jersey, and in a few cases the station at Liberty State Park may be the only extant New Jersey site for them. Records were checked at the Chrysler Herbarium, Rutgers University (CHRB); the New York Botanic Garden (NY); and The Academy of Natural Sciences of Philadelphia (PH). Specimens of these plants have been deposited in the Chrysler Herbarium.

Apera interrupta (Agrostis interrupta). This European grass may not have been collected in New Jersey before. There are no specimens from New Jersey in the PH, CHRB, or NY herbariums, and there are no records from either New York State or Pennsylvania. At Liberty State Park, it is scattered on sandy soil in a relatively small area south of the Environmental Center.

Bassia hyssopifolia. There are no collections of this plant from New Jersey in the herbaria checked. Snyder (1987) notes that there are three locations in New Jersey, in Cape May, Sussex, and Bergen counties. Just one plant was found at Liberty State Park, growing on sand at the edge of the salt marsh.

Calamagrostis epigeios. This grass from southern Europe is abundant in old fields at Liberty State Park, but may not have been collected in New Jersey before. There are no specimens from New Jersey at PH, CHRB, or NY. There are records from Long Island and from the Philadelphia area, however.

Diplotaxis tenuifolia. As with several unusual adventive species, there are records of this European mustard from ballast at Kaighn's Point, Camden County, from the 1860's to 1890's, with collections by such botanists as Isaac Martindale, Charles Smith, Albrecht Jahn, and C. F. Parker. There are also old records from Hudson County:

Jersey City, 1879, Schrenk, NY; and Hoboken, 1880, Brown, NY. The only recent New Jersey records seem to be Gloucester County: Westville, 1923, Long, PH; and Bergen County: Ross Dock, 1936, Monachino, NY. There are also some comparatively recent records from New York City. The plant is common on recently disturbed, sandy soil at Liberty State Park.

Epilobium hirsutum. There are a few relatively recent records of this rather showy European species, but in general it seems to be quite uncommon in New Jersey. Records include Camden County: Kaighn's Point, 1872, Parker, CHRB; and Atco, 1899, Mcfarlane, CHRB; Burlington County: Palmyra, 1937, Hynes, PH; Passaic County: West of Paterson, 1949, Schaeffer, PH; and Hudson County: Communipaw Ferry, 1880, Brown, NY; and Secaucus, 1970, Sipple, PH. Only a few plants were seen at Liberty State Park.

Erysimum repandum. There are half a dozen records of this European mustard from ballast at Kaighn's Point, Camden County, dating from the 1860's to 1890's, but only a few other New Jersey records, most of them very old. These include specimens from Hudson County: Jersey City, 1879, Britton, PH; the same site, 1879, Brown, CHRB; Communipaw Ferry, 1879, Brown, CHRB; and the same site, approximately the same date, LeRoy, NY. There is one relatively recent specimen from Monmouth County: Wickatunk, 1956, Frazee, PH. This species is present in small numbers at Liberty State Park, in disturbed soil along the waterfront by Morris Pesin Drive, and near Audrey Zapp Drive.

Juncus torreyi. The station at Liberty State Park appears to be the only extant location in New Jersey for this possibly-native species. The records from New Jersey include Camden County: Petty Island, 1868, Burk, PH; and the same location, 1868, Parker, NY; Ocean County: Lakehurst, 1904, Curtis, PH; and Cape May County: Cold Spring, 1972, Abraitys, PH. At Liberty State Park, this plant is scattered in wet swales along Freedom Way.

Verbena bracteata. This western Vervain has been collected only rarely in New Jersey in this century, although there are numerous records from ballast at Kaighn's Point, Camden County, from the 1860's to 1890's. Other records include Hudson County, Weehawken, 1894, Van Sickle, NY; Sussex County, Sparta Twp., 1938, Edwards, CHRB; and Burlington County, Lebanon State Forest, 1984, Anderson, PH. At Liberty State Park, there are only a few plants, growing in a thin lawn on dry cinder ballast north of Audrey Zapp Drive.

Verbena stricta. This Vervain from the western United States has been collected in New Jersey only half a dozen times. Records include Hudson County: New Durham, 1893, Van Sickle, NY; Ocean County: Toms River, 1900, Brown, PH; Cape May County: Reed's Beach, 1934, Brown, PH; and West Cape May, 1932, Brown, PH; Morris County: Budd Lake, 1939 and 1946, Monachino, NY; and Hunterdon County: Stanton Station, 1971, Abraitys, CHRB. There are several dozen plants at Liberty State Park, growing along a disused road through the undeveloped section of the Park.

Dittrichia graveolens. This European member of the *Asteraceae* has not been collected in New Jersey before. There are records from New York State, however, including Bronx County, 1949, Moldenke, NY; and the same site, 1949, Monachino, NY; and Brooklyn: 1959, Monachino, NY. There is a sight record from Staten Island, by Robert Meyers (ca. 1979). At Liberty State Park, it is fairly common along roadsides near the Environmental Center.

Polanisia dodecandra (P. graveolens). There are many records of this plant from Pennsylvania and from New York State, but New Jersey records are few. There is one record for Burlington County: Roebling, 1971, LaPort, CHRB; and an old record for Camden County: On ballast, Camden, 1852, Porter, NY. There are no New Jersey records at PH. At Liberty State Park, a few plants were found growing on cinder ballast east of Freedom Way.

REMARKS

At first glance, Liberty State Park appears to be an unpromising botanical site. However, 331 species of plants were found during this survey, not counting species that were obviously planted. Of the total, 185 species (56%) are native to North America, north of Mexico. The remaining 146 species (44%) are mostly familiar weeds, generally of European origin, but include a few plants that are unusual for New Jersey. It is tempting to think that some of these may have been persisting at Liberty State Park since the site was a ballast dump. Of the North American species, several have their origins in the southern or western United States, including such familiar plants as *Froehlichia gracilis, Coreopsis lanceolata, Helianthus annuus,* and *Mirabilis nyctaginea,* but also including the comparatively unusual *Taxodium distichum, Cycloloma atriplicifolium, Verbena bracteata, Verbena stricta,* and *Polanisia dodecandra.* It is possible that seeds of these plants were brought to the Liberty State Park area by the railroads, during their occupation of the site.

It is not probable that all these plants will continue to exist at Liberty State Park. Improvements planned or proposed for the Park include a 43 million dollar Science Center, a 10,000-seat amphitheatre, a marina, a 1.3 mile waterfront promenade, greatly expanded parking facilities, and a golf course, all on areas that are now undeveloped old fields. However, it is possible that some of these plants may be more common than the rather few collections would indicate, simply because they are likely to be found in disturbed environments which are often neglected by field botanists.

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Submerged Vascular Plants in the Delaware River from the Delaware Water Gap to Trenton

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During the summer and fall of 1983, I surveyed the submerged vascular plants in the Delaware River from the Delaware Water Gap downstream to Trenton. The portions of the river from the Water Gap to Riegelsville and from Upper Black Eddy to Point Pleasant were surveyed by canoe over a period of three days. The remaining portions were surveyed by wading into shallow water at scattered shoreline sites over a period of four days. The results of this survey are recorded in Table 1 and discussed further below. Voucher specimens are deposited in the herbarium of The Academy of Natural Sciences.

Data from herbarium specimens at the Academy of Natural Sciences (PH = Academy collections; PENN = University of Pennsylvania collections) and at Rutgers University (CHRB) were recorded to document previous occurrences of submerged vascular plants in this stretch of the river. However, most of these plants were probably more widespread than indicated by previous collections because botanists generally overlook underwater plants.

Regional floras (Benner 1932; Britton 1889; Schaeffer 1949) were consulted for distributional data on submergents. Information from these books corroborated data from herbarium specimens for the most part.

1988 DISTRIBUTIONS AND PREVIOUS COLLECTIONS

Ceratophyllum demersum

1988: Found at (1) Riverton, (2) below Riegelsville near the lower end of Lynn Island, and (3) Upper Black Eddy.

Previous Collections: None known.

Elodea canadensis and E. nuttallii

1988: Plants of the genus were found along the entire stretch from the Water Gap to Trenton, but were more frequent and abundant upstream than downstream. Many of the plants we saw were not identified to species. No plants resembling *E. canadensis* were found below the vicinity of Riegelsville; those resembling *E. nuttallii* were found downstream to Trenton and into the estuary.

Previous Collections: Collections identified as both species were previously made in the vicinity of the Water Gap with those of *E. canadensis* occurring downstream to Brownsburg (between New Hope and Washington Crossing) where collected in 1931 (Long 36026, PH). Collections of *E. nuttallii* were previously made downstream to Trenton and into the estuary where the plants are still found.

Heteranthera dubia

1988: Water Gap downstream to Washington Crossing; more frequent and abundant upstream than downstream; few plants seen below Point Pleasant.

Previous Collections: Vicinity of Columbia downstream to northwest of Morrisville where collected in 1931 (Long 35894, PH).

Myriophyllum spicatum

1988: Vicinity of Manunka Chunk downstream to Trenton and into the estuary; more frequent and abundant downstream than upstream.

Previous Collections: No collections of this Eurasian introduction are known from this stretch of the river before 1972 when they were made in the vicinity of Milford (Roberts 3074, PH), Washington Crossing (Roberts 3086, PH), and Scudders Falls (Roberts 3048, PH). The earliest known collection from the Delaware River Basin was at Lake Musconetcong in 1952 (Patten, CHRB).

Najas flexilis

1988: No plants observed.

Previous Collections: One collection at Point Pleasant in 1923 (Long 28778, PH).

Najas gracillima

1988: No plants observed.

Previous Collections: One collection at Point Pleasant in 1923 (Long 28780, PH).

Podostemum ceratophyllum

1988: Water Gap downstream to the upper end of Masons Island above Roxburg.

Previous Collections: Vicinity of Riverton downstream to Morrisville where collected in 1872 (I. Burk, PENN, PH). All collections below Martins Creek were made in the 19th century.

Comments: The algal genus *Lemanea* grows attached to rocks in swift water in the downstream portion of the river in habitats similar to those in which *Podostemum* grows farther upstream.

Potamogeton alpinus

1988: Vicinity of Slateford downstream to the lower end of Macks Island above Belvidere.

Previous Collections: Belvidere downstream to Point Pleasant where collected in 1923 (Long 28782 and 28824, PH).

Comments: E. C. Ogden identified specimens collected by Schaeffer (22598, PENN, PH) in the Delaware south of Coffeetown as "probably *P. gramineus* L. × *perfoliatus* L." Hybrids between *P. gramineus* (or *P. illinoensis*) and *P. perfoliatus* presumably would resemble *P. alpinus*. Further study of plants resembling *P. alpinus* in the Delaware River Basin is needed to determine whether they are such hybrids or *P. alpinus*. None of the specimens identified as *P. alpinus* from the Delaware River Basin has fruits.

Potamogeton amplifolius

1988: No plants observed.

Previous Collections: Specimens from Belvidere in 1885 (Britton, CHRB) and from Martins Creek in 1906 (Williamson, PH) are presumably from the Delaware River.

Potamogeton crispus

1988: Water Gap downstream to the vicinity of Titusville; more common upstream than downstream; few plants seen below Point Pleasant.

Previous Collections: Vicinity of Portland downstream to Yardley where collected in 1958 (Long 83800, PH). A collection from Trenton in 1887 (herb. Apgar, PH) may be from the estuary. The earliest known collections of this Eurasian introduction from the stretch of the river between the Water Gap and Trenton were made in 1886 at Monroe (J. A. and H. F. Ruth, PH) and Raven Rock (Best, PH).

Potamogeton epihydrus

1988: No plants observed.

Previous Collections: "Pond on the Delaware above Easton" in 1868 (Porter, PH) and at Monroe in 1885 (J. A. and J. F. Ruth, PH). A collection from Upper Black Eddy in 1909 (Eckfeldt, PENN) may have come from the Delaware River.

Potamogeton foliosus

1988: No plants observed.

Previous Collections: "Pond on the Delaware above Easton" in 1868 (Porter, PH). An 1895 collection from Stockton (Fisher, PH) may have come from the Delaware River.

Potamogeton illinoensis

1988: Few stands below Slateford.

Previous Collections: Three collections from (1) Pot Rock above Easton in 1891 (Porter, PH), (2) Ridges (Treasure) Island in 1885 (Best, PH), and (3) Tumble Station (between Frenchtown and Point Pleasant) in 1885 (Porter, CHRB).

Potamogeton nodosus

1988: Columbia downstream to below Hutchinson and above Keifer Island.

Previous Collections: Columbia downstream to below Yardley where collected in 1958 (Long 83796, 83798, and 83801, PH).

Potamogeton pectinatus

1988: Vicinity of Raubsville downstream to Treasure Island (below Frenchtown).

Previous Collections: Two collections from (1) one mile south of Raven Rock in 1972 (Roberts 3078, PH) and (2) Yardley in 1958 (Long 83797, PH). There is a collection from Lambertville in 1886 (Schuh, PH) that may have come from the river. In November 1957, W. L. Dix collected floating plants at Stockton, near Scudder's Falls, and Morrisville (specimens at PH).

Potamogeton perfoliatus

1988: Vicinity of Slateford downstream to the vicinity of Manunka Chunk.

Previous Collections: Vicinity of Columbia downstream to Lambertville where collected in 1940 (Benner 9467, PH).

Potamogeton pusillus

1988: No plants observed.

Previous Collections: Point Pleasant downstream to above New Hope where collected in 1937 (True 4348, PENN) and Lambertville where collected in 1932 (Long 38587, PH) and 1940 (Benner 9463, PH).

Potamogeton richardsonii

1988: No plants observed.

Previous Collections: Two collections from (1) ¼ mile southeast of Columbia in 1957 (Schaeffer 55582, PH) and (2) Belvidere in 1885 (Britton, CHRB).

Potamogeton spirillus

1988: No plants observed.

Previous Collections: Riverton and Belvidere downstream to Lambertville where collected in 1940 (Benner 9464, PH).

Ranunculus longirostris

1988: Few plants found at (1) the Water Gap, and (2) below Frenchtown on the east side of Marshall Island.

Previous Collections: One early collection at Stockton (Fisher, PH) may have come from the Delaware River.

Comments: This species closely resembles *Ranunculus trichophyllus*, which Britton reported (as *R. aquatilis* var. *trichophyllus*) was "Frequent in the Delaware River" in Warren County, New Jersey. Our collections lacked flowers and fruits; the petiole lengths (less than 1 cm) were more similar to *R. longirostris* than to *R. trichophyllus*.

Vallisneria americana

1988: Water Gap downstream to Washington Crossing; few plants seen below Stockton.

Previous Collections: Vicinity of Columbia downstream to southeast of Yardley where collected in 1958 (Long 83794, PH).

Discussion

The most common species found in the Delaware River between the Water Gap and Trenton were *Elodea nuttallii, Heternathera dubia, Myriophyllum spicatum, Potamogeton crispus*, and *Vallisneria americana*. These were the only species found in Zone 5 (Table 1), the zone with the fewest species.

Six species were not found downstream as far as they have been in previous years: (1) *Elodea canadensis*, which previously occurred downstream to Zone 5, was not found below Zone 3; (2) *Podostemum ceratophyllum*, which previously occurred downstream to Zone 5, was not found below Zone 2; (3) *Potamogeton alpinus*, which previously occurred downstream to Zone 4, was not found below Zone 1; (4) *Potamogeton illinoensis*, which previously occurred in Zones 2 and 4, was not found below Zone 1; (5) *Potamogeton nodosus*, which previously occurred downstream to Zone 5, was not found below Zone 3; (6) *Potamogeton perfoliatus*, which previously occurred

TABLE 1. Distribution of Submerged Vascular Plants from the Delaware Water Gap to Morrisville-Trenton recorded in 1988.

Zone 1: Water Gap to Riverton-Belvidere: *Ceratophyllum demersum, Elodea canadensis, Heteranthera dubia, Myriophyllum spicatum, Podostemum ceratophyllum, Potamogeton alpinus, Potamogeton crispus, Potamogeton illinoensis, Potamogeton nodosus, Potamogeton perfoliatus, Ranunculus longirostris, Vallisneria americana.*

Zone 2: Riverton-Belvidere to Easton-Phillipsburg: *Elodea nuttallii, Heteranthera dubia, Myriophyllum spicatum, Podostemum ceratophyllum, Potamogeton crispus, Potamogeton nodosus, Vallisneria americana.*

Zone 3: Easton-Phillipsburg to Uhlerstown-Frenchtown: *Ceratophyllum demersum, Elodea canadensis, Elodea nuttallii, Heteranthera dubia, Myriophyllum spicatum, Potamogeton crispus, Potamogeton pectinatus, Vallisneria americana.*

Zone 4: Uhlerstown-Frenchtown to New Hope-Lambertville: *Elodea nuttallii, Heteranthera dubia, Myriophyllum spicatum, Potamogeton crispus, Potamogeton pectinatus, Ranunculus longirostris, Vallisneria americana.*

Zone 5: New Hope-Lambertville to Morrisville-Trenton: *Elodea nuttallii, Heteranthera dubia, Myriophyllum spicatum, Potamogeton crispus, Vallisneria americana.*

downstream to Zone 4, was not found below Zone 1. *Potamogeton perfoliatus* was also known from the Delaware Estuary where it was last collected in 1927 (Schuyler 1988).

One previously widespread species, *Potamogeton spirillus,* was not found in 1988. It was last collected along this stretch of the river in 1943 east of Churchville (Schaeffer 14664, PENN). This species was also known from the Delaware River below Trenton where it was last collected at Andalusia in 1923 (Dreisbach 1854, PENN; Long 28413, PH).

The remaining species known from this stretch of the river are or were only known from a few places. It is possible that some of them were more widely distributed in the past but we have no hard evidence to support this. Some of the previously collected species could have been overlooked during the 1988 survey.

The results of this survey indicate that there has been a reduction of the native submergent flora of the Delaware River between the Water Gap and Trenton during the 19th and 20th centuries. Most of this reduction has occurred in the downstream portion of this stretch of the river. Offsetting this reduction to some extent is the introduction of two Eurasian species, *Myriophyllum spicatum* and *Potamogeton crispus,* which now are among the five most common species in the river. *Myriophyllum spicatum* differs from the other species because it is more abundant in the downstream zones where they are scarce or absent. It also grows in swifter water than where most of the other species are usually found.

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OBITUARY

Michael Alvin Barnett (28 November 1945–21 December 1988). The recent passing away of Michael Barnett is mourned by our members who were associated with him in the exploration of New Jersey's flora. His strong knowledge of nature, tireless enthusiasm, and keen sense of humor will be sadly missed by all of his colleagues.

Michael's childhood was spent on an Atlantic-barrier beach (Margate, New Jersey) and his playgrounds extended from the ocean-beach area, through the marshes and tidal bays, to the Pine Barrens. Interest in nature was life-long as demonstrated by his vocation in oceanography and an avocation devoted to the botany of these areas.

Michael received his Ph.D. in 1975 from the Scripps Institue of Oceanography in LaJolla, California. He served as a Research Associate in Icthyology at the Los Angeles County Museum of Natural History and also worked for many years as a consultant specializing in marine ecology and conservation.

Michael's second avocation was his study of music, particularly classical. He had a collection of over 6,000 records and is known to have introduced many narrow-spectrum scientists to the wonders of fine music.

In 1980 he relocated to the East Coast and worked for the Nature Conservancy searching for endangered plants and identifying critical habitat in New Jersey. During this work Michael's indefatigable nature became very apparent to his co-workers. While others working on a project with Michael had called it a day and gone home, he could still be found in the field searching. Michael also had a wonderful sense of humor, and on those unamusing summer days in the Pine Barrens, when the air was humid, the sun was hot, and the ticks, chiggers, flies, and mosquitoes were ubiquitous, his badinage was most welcome.

In 1985 Michael left New Jersey to join the National Oceanic and Atmospheric Administration's Strategic Assessments Branch in Maryland. While there he worked on developing biogeographic information on the Nation's coastal waters. He made important contributions to many Strategic Assessment projects, specifically in the regions of the Bering, Chukchi, and Beaufort Seas and the West Coast of North America.

One of Michael's favorite places in New Jersey was Bennetts Bog in Cape May County, which is home to a number of rare and endangered plant species. At Michael's request, his ashes were distributed there.

Gerry Moore

Bartonia No. 55: 60–61, 1989

REVIEW

Sexuality in Plants and Its Hormonal Regulation, by M. K. Chailakhyan and V. N. Khrianin (transl. and edited by K. V. Thimann). Springer-Verlag, New York. 1987. xiv + 159 pp. $67.00.

As is aptly pointed out by this volume, we are not likely to make significant improvements in the production of crop plants unless we understand the factors which control and influence the flowering of plants and the expression of sex by these flowers. The plants on which we are dependent for grains, oilseeds, fruits, and some fibers must flower before they produce the structures with economic value. Even those from which we get essential oils and flavors, stem and leaf (bast) fibers, and vegetables (non-reproductive produce) must flower to produce seed for the next season. It is for that reason that this book was written as a survey of what is known about sexuality and flowering in plants.

One cannot long study plant hormones and growth substances without encountering the name of MK Chailakhyan, the discoverer of the putative flowering hormone "florigen." It was hoped that this book would relate the latest evidence for or against the existence of this elusive substance and the experiments which would elucidate the initiation of flowering after the appropriate stimulus; in that regard this book is disappointing, especially since "florigen" is not mentioned anywhere in the book. (Recent studies designed to examine the existence of "florigen" and an antagonist, "antiflorigen," are described in a paper by Lang (1987).) What the book does relate is a wealth of experimental data, both historic and recent, relating to those factors which influence the expression of sexuality in dioecious plants (especially hemp and spinach) and monoecious plants with unisexual flowers (such as, corn and cucumber). Studies are covered in successive chapters on the genetics of plant sexuality, epigenetic effects, and the influence of temperature, daylength, light quality, and the better characterized plant hormones (auxins, cytokinins, gibberellins, ABA, ethylene, and synthetics) on the expression of maleness or femaleness by the flowers of these plants, whether through enhanced expression of the normally lesser-expressed sex or complete switching of a genetic male or female plant to the opposite sex. Studies include those made with high doses of the substances of interest (lanolin, injection, spraying, and similar experiments) singly and in combination, examination of endogenous hormone levels and ratios in plants or parts of plants expressing a given sex, the influence of presence and absence of specific organs on sex expression, and tissue culture experiments with analysis of exogenous effect and endogenous hormone levels. Especially interesting are the discussions related to the experiments in which leaves or roots or both are removed and the influence on sex expression, particularly in regard to the implications for the requirements of specific hormones for the expression of a particular sex, was studied. For example, root removal stimulates the production of male flowers in hemp and spinach, suggesting that cytokinins, produced by the roots, are required for the expression of female flowers; similarly, gibberellins are felt to be a male hormone, since these compounds, or leaf removal, induced the production of female flowers. As confessed by the authors, the only type of plant not well researched have been those with perfect, or hermaphroditic, flowers, except when induced in a normally dioecious or monoecious plant by a particular treatment. It can only be hoped that these and other researchers will examine the more general, and perhaps primitive, plant form with a similar breadth of approach.

The majority of references, especially for the work with hemp and spinach, are by Soviet or Eastern European scientists, and so, this book provides an avenue into literature seldom well-known by scientists in the West, but many studies by scientists in western Europe and the U.S. are also cited. The editing is of a high quality and there are no errors which lead to a misunderstanding of the text. A major failing of the original text (published in 1982), is that the references are somewhat dated, the most recent being 1977 and most much earlier. But the editor has been careful in the translation to provide more recent references pertinent to the discussion and occasionally give credit for priority of a finding by a western scientist.

Although this is a book which deals with much information on a poorly understood topic, it is concise and highly readable. The present volume should make a welcome addition to the reading of students of crop physiology, hormone physiology, experimental horticulture, and plant development and institutional libraries with undergraduate or graduate courses in these areas.

REFERENCE

LANG, A. 1987. Perspectives in flowering research. Pages 3–24 *in* J. L. Key and L. McIntosh, eds. Plant Gene Systems and Their Biology. Alan R. Liss, Inc., New York.

JOHN R. PORTER

NEWS AND NOTES

CASTANEA PUMILA FOUND IN ATLANTIC COUNTY, NJ. During the summer and fall of 1988, while delineating wetlands on the Mays Landing Country Club's golf course, Hamilton Township, I found scattered individuals of *Castanea pumila* (L.) Mill. adjacent to a hardwood swamp in an area of mixed oak and pine. The first specimen examined possessed thin glabrate leaves and probably represents a shade form as mentioned in *Gray's Manual of Botany*. Other individuals had thicker leaves which were gray-tomentose underneath. All individuals found were shrub forms under 4 feet tall with no evidence of being root sprouts. No fruits were present at time of investigation. BILL OLSON

NEW JERSEY WILD PLANTS. Written by Mary Y. Hough and published in 1983, the book *New Jersey Wild Plants* may be purchased by sending a check for $15.00 to Mary Y. Hough, No. 1, Route 94, Blairstown, NJ 07825 and a copy will be sent postpaid. DAVID E. FAIRBROTHERS.

NEW JERSEY'S RARE AND ENDANGERED PLANTS AND ANIMALS CONFERENCE PROCEEDINGS. The proceedings of the conference on Rare and Endangered Plants and animals, held at Ramapo College on October 23, 1987, is now available. The conference was sponsored by the Institute for Environmental Studies, School of Theoretical and Applied Science, Ramapo College of New Jersey, 505 Ramapo Valley Road, Mahwah, NJ 07430-1680. The proceedings, with 150 pages, includes appendices with complete lists of Federal and New Jersey state rare and endangered plants and animals. It is edited by Dr. Eric Karlin, Professor of Biology, School of Theoretical and Applied Science and Director of the Institute for Environmental Studies. Contact the Institute for Environmental Studies or call (201) 529-7742 or 7747 for further information. DAVID E. FAIRBROTHERS.

CENTENNIAL CELEBRATION. The Philadelphia Botanical Club will celebrate its Centennial in 1991. The Centennial Committee (J. Arsenault, E. Farley, K. Fogarasi, R. Hill, E. McLean, A. E. Schuyler, Chairman) has begun planning activities for the centennial year. Several full day programs are planned, in addition to the regularly scheduled evening lectures. Financial support is needed if we are to successfully carry out an interesting, diversified program, publish the centennial issue of *Bartonia*, and produce a brochure to help publicize centennial activities.

With the approval of the Philadelphia Botanical Club membership, a Centennial Fund has been established. Contributions to this fund from members and non-members will be greatly appreciated and used to defray the costs of the above mentioned activities. PLEASE HELP SUPPORT OUR CENTENNIAL CELEBRATION! SEND YOUR CONTRIBUTION TO: PHILADELPHIA BOTANICAL CLUB/CENTENNIAL FUND, Department of Botany, Academy of Natural Sciences, 19th & Parkway, Philadelphia, PA 19103. KASIA FOGARASI.

Bartonia No. 55: 63–67, 1989

1988 FIELD TRIPS

April 16: Plains of Burlington and Ocean counties, NJ. In the West (Upper) Plains north of Route 72 near Coyle Airfield, we saw *Epigaea repens, Arctostaphylos uva-ursi, and Pyxidanthera barbulata* blooming in wind-swept sand. Here we examined a Silas Little experiment plot harboring a stand of *Pinus strobus* with several individuals towering to 10 m. The vigorous growth of these trees convinced us that soil impoverishment is not the cause of the low stature of the Plains vegetation. At the very headwaters of the Plain Branch (now dessicated), we encountered impressive stands of *Muhlenbergia torreyana* and *Calamovilfa brevipilis,* two grasses apparently never before reported from this region. Nearby, we hiked to the high ridges (over 50 m) for a spectacular 360° view of this extensive pygmy forest. In search of *Corema conradii,* we followed the footsteps of Witmer Stone, visiting the ''inn'' at Cedar Bridge. In the East (Lower) Plains south of the village of Warren Grove, we saw massive cushions of *Corema* still in anthesis, some more than a meter across. We had come here specifically to assess the effect of a July 1983 wildfire on a large population of this globally rare species. At Watering Place Pond all *Corema* cushions in the path of the fire were totally consumed by the flames. However, scattered, 1–2-year old seedlings, originating from adjacent plants that escaped the fire, hold promise for the future. Leader: Ted Gordon.

14 May: Fern Hill Serpentine Barrens, Chester County, PA. All the usual rare plants of a serpentine barren were present and most of them blooming: *Arabis lyrata, Cerastium arvense* var. *villosum, Arenaria stricta, Viola fimbriatula, Oenothera lacinata, Senecio smallii, Asclepias verticillata, Phlox subulata, Aster depauperatus, Panicum oligosanthes,* as well as two special species which this particular barrens is well-known for—*Bouteloua curtipendula,* a prairie disjunct, and *Talinum teretifolium,* a Pennsylvania serpentine endemic. *Talinum* blooms for about an hour from 3 to 4 in the afternoons of August, so we didn't catch its flower, but its distinctive acicular succulent leaves were quite apparent between the small cracks in the serpentine rocks and in the bare depressions on top of the large flat serpentine. In past recent years, *Talinum* had been found only on the western sections of these barrens—the part which belongs to the North Penn Hills Civic Association and which was recently placed under the protection of the Nature Conservancy. But on this visit, *Talinum* was found also in the eastern section, quite far from the first stand. The eastern section had been engulfed in a sweeping fire three years ago which presumably stimulated dormant *Talinum* seeds. For all of us present this was an unknown and exciting phenomenon to learn about. The edge trees were the main two barrens trees, *Quercus marilandica* and *stellata* with *Sassafras albidum* and *Robinia pseudo-acacia* creeping in. The grass was mostly *Schizachyrium scoparim,* but by the stream was a stand of *Deschampsia caespitosa.* We shouldn't forget to mention that the usual *Smilax rotundifolia* was with us to remind us that Life is not all Pure Pleasure. Leader: Ann Newbold.

May 21: White Clay Creek Natural Area, Chester County, PA, and New Castle County, DE. We walked along an old railroad bed and a creekside path through some of the richest piedmont forests and thickets in Chester and New Castle counties, observing a good number of local and state plant rarities, some of which proved to be new records for the Preserve. On the Pennsylvania side of the border, we saw such species as *Oxalis violacea, Mitella diphylla, Viola rotundifolia, V. stoneana,* and *V. blanda,* *Trillium cernuum, Aplectrum hyemale* (in bloom), *Chamaelirium luteum, Melanthium hybridum,* and *Cystopteris protrusa.* On the Delaware side of the line, we observed *Arisaema dracontium* (a dense colony), *Oxalis violacea, Polemonium reptans, Viola stoneana,* and a number of *Carex* species, including the following new Preserve records: *Carex bromoides, C. complanata,* and *C. ormostachya,* the last of which was also found in Chester County and was a new county record, and apparently a new Delaware state record. Most impressive was the great profusion of *Orobanche uniflora* that we found in bloom in both states throughout the walk. Leaders: Jack Holt, Janet Ebert.

June 4: John and Beth Mitchell property, Delaware Township, Hunterdon County, NJ. Numerous sedges and grasses were the highlights of this trip through several different habitats including floodplain forest, mature hemlock forest, shale escarpments and seeps, sugar maple-basswood forest (2nd growth), oak-hickory forest, old fields dominated by red cedar, slippery elm-white ash (2nd growth), lawns, and agricultural fields. Robert C. Meyer, Jr., identified numerous grasses and sedges such as *Festuca elatior, F. rubra, Poa annua, P. trivialis, P. pratensis, P. compressa, Bromus commutatus, Calamagrostis canadensis, Sphenopholis intermedia, Phalaris arundinacea,* and *Carex rosea, blanda, squarrosa, swanii, stipata, digitalis, annectens, complanata,* and *cristatella.* Among the more interesting plants observed in shale ledges and escarpments were *Heuchera americana, Parietaria pensylvanica, Aquilegia canadensis* (in fruit), *Cystopteris fragilis, Asplenium platyneuron* and *Woodsia obtusa.* Leader: John D. Mitchell.

July 16: Bowman's Hill State Wildflower Preserve, Bucks County, PA. Ferns and fern allies were the featured flora of the trip. Among the forty species seen were *Selaginella apoda, Lycopodium palmatum, Cheilanthes lanosa,* both *Woodwardia* species, *Diplazium (Athyrium) pycnocarpon, Deparia acrostichoides (Athyrium thelypteroides), Woodsia obtusa, Cystopteris protusa, Thelypteris palustris* var. *pubescens* compared to *Thelypteris simulata, Gymnocarpium dryopteris, Dryopteris campyloptera, D. goldiana, D. clintoniana, D. × bootii, D. × slossoniae, D. × separabilis, D. × triploidea* and *Polystichum braunii.* Leaders: Greg Edinger and Bill Olson.

July 23: Tinicum National Environmental Center, Philadelphia, PA. We walked 3.5 miles around the impoundment. Some of the plants in bloom were *Rhexia mariana, Hibiscus palustris, Spirea tomentosa, Polygala sanguinea, Eupatorium purpureum, Strophostyles umbellata, Polygonum orientale, Verbascum blattaria, Verbena hastata,* and *Verbena urticifolia.* Special thanks go to Janet Ebert and Jack Holt for their help. Leader: John Ballas.

August 6: Manumuskin River, Cumberland Co., NJ. We began this trip by revisiting Witmer Stone's station for *Ipomopsis rubra* and were delighted to find the plant still thriving here. We then proceeded east along the railroad tracks and visited a boggy area near the river. Here we found *Drosera intermedia, Lycopodium appressum, Pogonia ophioglossoides* (in fruit), *Rhexia virginica, Rhynchospora capitellata, Sarracenia purpurea, Utricularia geminiscapa, U. subulata,* and *Vaccinium macrocarpon.* The group then went into a freshwater tidal marsh to see the globally rare *Aeschynomene virginica.* In a pine-oak forest we saw a fine stand of *Clitoria mariana* in bloom.

The Cumberland Furnace site was then visited where, growing near the slag, we saw such atypical Pine Barren species as *Asplenium platyneuron, Belamcanda chinensis, Liparis lilifolia* and *Pyrola americana.* A stop by a field near Cumberland Pond allowed us to see the rare *Desmodium strictum, Toxicodendron toxicarium,* and *Jasione montana* growing with more common field species such as *Asclepias amplexicaulis, A. tuberosa, Diodia teres,* and *Opuntia compressa.* We ended our trip along an easement line near the pond where we searched unsuccessfully for *Eupatorium resinosum* and *Platanthera ciliaris* but did record *Aletris farinosa, Amphicarpum purshii, Coreopsis rosea, Eupatorium leucolepis, Euthamia tenuifolia, Hypericum stans, Lobelia canbyi, Lobelia nuttallii, Platanthera blephariglottis, Polygala cruciata, P. lutea, P. nuttallii,* and *Rhexia mariana.* Leader: Gerry Moore.

August 7: Cape May State Park and Bennett's Bog, Cape May County, NJ. At Cape May State Park the following plant species were among those observed: *Helianthus giganteus, Apios americana, Hibiscus mocheutos, Kosteletzkya virginica, Sabatia angularis,* and *Baccharis halmifolia.* After lunch at the State Park, the group traveled to Bennett's Bog to spend the afternoon in these two vernal ponds. Some of the plant species observed were: *Glyceria obtusa, Muhlenbergia torreyana, Panicum rigidulum, Manisuris rugosa, Cladium mariscoides, Platanthera nivea, Myrica cerifera, Hypericum adpressum, H. denticulatum, Eryngium aquaticum, Boltonia asteroides,* and *Sclerolepis uniflora.* Leader: Bill Olson.

August 13: Clark's Pond/Dix Wildlife Refuge, Fairfield Township, Cumberland County, NJ. We began to botanize a field near Clark's Pond, but upon determining it to be chiefly dominated by *Rosa multiflora* and *Rubus* we opted to walk along its edge. Here we saw *Asclepias tuberosa, Eupatorium album, E. hyssopifolium, Desmodium paniculatum* and *Diodia teres.* A small patch of *Desmodium viridiflorum,* a rare species in NJ, was also discovered here. Along a path bordering the pond we saw fine specimens of *Quercus michauxii,* growing with *Acer rubrum, Nyssa sylvatica,* and *Liquidambar styraciflua.* Beyond a slope vegetated with *Smilax rotundifolia* and *Toxicodendron radicans,* Clark's Pond was bedecked with blooms of *Nuphar lutea, Nymphaea odorata, Spiraea tomentosa, Utricularia fibrosa* and *U. geminiscapa.* We then visited the Dix Wildlife Refuge, near Lanings Wharf, and walked along Schoolhouse Road to see *Lycopodium clavatum* and a fine stand of the rare *Polygala mariana* in full bloom. A rich lowland woods was then explored in the hopes of rediscovering *Ruellia caroliniensis,* recorded here by Bayard Long in 1935. Our attempts failed as we found not a single *Ruellia* specimen. Our spirits were uplifted somewhat through the discovery of a small patch of *Tipularia discolor* with one plant in full bloom. Leader: Gerry Moore.

August 20: Pennsylvania State Game Lands 141, Hughes Swamp, Carbon County, PA. We explored the wetlands and adjacent communities in Hughes Swamp. Good examples of acidic scrub/shrub habitats were looked at. The following plant species were among those seen: *Lycopodium palmatum, Thelypteris simulata, Drosera rotundifolia, Chamaedaphne calyculata, Lyonia ligustrina, Cornus canadensis, Nemopanthus mucronata, Bartonia virginica, Gentiana linearis, Aster acuminatus,* and *Amianthium muscaetoxicum.* A preliminary plant list was provided to those attending the trip. Leader: Bill Olson.

August 27: Double Trouble State Forest, Ocean County, NJ. We visited upland pine forests, White Cedar swamps, and the edges of cranberry bogs. Typical Pine Barrens flora was seen. Several species of *Eupatorium*, including *E. resinosum, E. album, E. dubium, E. leucolepis, E. pilosum,* and *E. hyssopifolium* were noted and compared. A few of the many grasses seen were *Amphicarpum purshii, Zizania aquatica, Aristida oligantha, Panicum verrucosum,* and *P. longifolium*. Sedges included *Cyperus retrorsus, C. dentatus,* and *C. grayii; Rhynchospora alba, R. gracilenta,* and *R. capitellata; Eriophorum virginicum;* and *Cladium mariscoides*. A good variety of Saint John's-worts were in bloom, among them *Hypericum densiflorum, H. stans, H. denticulatum, H. hypericoides, H. gentianoides,* and *H. canadense; H. virginicum* was also seen, but past flowering. Other plants of particular interest were *Smilax laurifolia, Potamogen confervoides, Juncus biflorus, J. pelocarpus, Sabatia difformis, Polygala lutea, P. cruciata, P. brevifolia, Minuartia caroliniana, Sarracenia purpurea,* and *Toxicodendron vernix*. Leader: Karl Anderson.

September 9: Makepiece Lake and Vicinity, Atlantic County, NJ. We began the trip by exploring the lands between the dirt access road and the abandoned cranberry bogs on the west side of Weymouth-Elwood Road. After a brief walk we made our way to the east side of the road and found the main reservoir water level of Makepiece Lake very low. This gave us ample room to walk the shoreline where we saw typical Pine Barrens species such as *Juncus militaris, Cladium mariscoides, Juncus canadensis, Juncus pelocarpus* in addition to the smaller, less abundant *Xyris caroliniana, Xyris smalliana, Xyris torta, Hypericum boreale,* and *Lycopodium appressum, Lycopodium alopecuroides* and *Glyceria obtusa*. The area was rich with a few species, and did not have a large diversity. This may have been due to the early stage of re-colonization of the shoreline from an earlier submerged condition. We next traveled south on Weymouth-Elwood Road to the eastern access road illustrated on the Newtonville, NJ, Quadrangle at BM 44. This dirt path followed a series of ancient stream terraces that have been reworked by wind and rain into longitudinal dunes. We followed the dunes southeast exploring the adjacent open wetland habitats, where we saw *Carex bullata* surrounding many of the open depressions with *Eleocharis tenuis, Eleocharis olivacea, Aster novi-belgii,* and *Rhynchospora gracilenta*. The group was surprised at the lack of diversity offered by many the open wetlands. It appears a recent cedar logging operation may have been a deciding factor. Leader: Joe Arsenault.

September 17: Warren Grove environs, Ocean and Burlington counties, NJ. Botanizing commenced at the edge of a well-stocked, regenerating cedar swamp at the intersection of Route 539 and the upper Oswego River. Here only a single, flowering plant of *Eupatorium resinosum* had escaped roadside mowing. Following the footsteps of John W. Harshberger, we stopped at the Cranmer Place, where he stayed overnight on botanical excursions to the Plains in the early nineteen hundreds. Having attracted the interest of botanists for decades, the adjacent, privately-owned fields are succumbing to succession. Among the diverse species in flower or fruit were *Helianthus angustifolius, Solidago stricta, Scleria triglomerata, S. pauciflora, Fimbristylis autumnalis, Rhynchospora torreyana, Desmodium ciliare, Gentiana autumnalis* (only 2 in flower), *Eupatorium leucolepis, Prenanthes autumnalis,* and *Liatris graminifolia* (including forma *albiflora*). Our search for *Aster concolor* and *Gentiana autumnalis* forma *albescens*, both known from here, proved unsuccessful. In a nearby, cutover cedar swamp bordering the Oswego River, we found *Ilex laevigata, Bartonia paniculata,* and a substantial population of *Rhynchospora chalarocephala.* A visit to the Le Clare "homestead" on the Plains reminded us of the growth potential of Plains sites protected from wildfire. Here we were amazed to see *Quercus* and *Populus* species exceeding heights of 13 m. Our trip concluded at the Federal Aviation Administration property west of Warren Grove, where we saw *Corema conradii, Calamovilfa brevipilis, Muhlenbergia torreyana, Carex livida, Rhynchospora knieskernii, Lycopodium carolinianum,* and *Lobelia canbyi.* Leader: Ted Gordon.

September 24: Malaga Road Gravel Pit, Monroe Township, Gloucester County, NJ. The eight members that participated in this outing enjoyed a cool, partly sunny day for a long walk around a gravel pit that was in the early stages of native plant re-establishment. The re-vegetation was required by a regional law and we came to see the success attained using low intensity measures. We began the walk by surveying the upland slopes and ended the morning by seeing new colonization on excavated wetlands. Species of interest found in this area included *Chrysopsis mariana, Aster linariifolius, Lespedeza virginica, Leontodon autumnalis, Polygala polygama, Solidago speciosa, Brasenia schreberi, Juncus marginalis, Solidago ludoviciana,* and *Gratiola aurea.* After a brief stop for lunch, we drove to the Cedar Lake area at the Gloucester-Atlantic County border. Here we saw *Ludwigia sphaerocarpa, Rhynchospora macrostachya, Erianthus giganteus, Aster nemoralis, Rhynchospora fusca,* and *Eupatorium resinosum.* The latter species occupied the rear of the lake, covering approximately 1 acre with associated rushes and sedges. Leader: Joe Arsenault.

Bartonia No. 55: 68–72, 1989

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28 Jan	Impressions of Berlin, Europe, and the 14th International Botanical Congress	E. Marie Boyle, D. G. Frodin A. Newbold, B. C. Stone
25 Feb	A Report on the Ramapo State College Symposium on New Jersey's Endangered Species	G. Moore
24 Mar	Natural Sources of Perfumes	A. O. Tucker
28 Apr	Developments at Scott Arboretum and on the Swarthmore College Campus	S. Wheaton
26 May	Review of 1987–1988 Field Trips	J. Arsenault
22 Sep	Slide Illustrated Report of Summer Botanizing	Club Members
27 Oct	The Genus *Paulownia*: Botany and Arboriculture	T. Storbeck
17 Nov	Aquatic Plants of the New Jersey Pine Barrens	J. M. Volk
15 Dec	The Limits of *Cornus*	R. H. Eyde

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Floristic Survey of the Enlow Fork Valley (Wheeling Creek), Western Pennsylvania

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Enlow Fork (also known as Enslow Fork) drains a watershed of approximately 47,000 acres (19,500 hectares) in southwestern Pennsylvania and northern West Virginia and is one of the main tributaries of Wheeling Creek. Following a history of severe flooding in Wheeling, West Virginia, an extensive flood prevention plan was developed and eventually implemented (Soil Conservation Service 1980). This plan included the construction of a dam on Enlow Fork approximately one kilometer east of the West Virginia border. Responding to concern about the impact of a permanent impoundment on the valley's vegetation and wildlife, the original plan was altered from a wet dam to a dry non-impounding dam, which was completed in June 1987. Prior to dam building, however, studies were initiated to determine the effects of such a structure on the natural history of the valley. In addition, the Western Pennsylvania Conservancy and the Pennsylvania Game Commission protected portions of the site through acquisition of property and the creation of a state game lands.

Although an environmental impact statement was compiled during the planning stages of the flood control project, few specific statements could be made regarding the potential impact of a dry dam on the flora and fauna within the limits of the future intermittent flood pools (Soil Conservation Service 1979, 1980). As a baseline against which to monitor future changes in the flora of the Enlow Creek valley, this study provides an overview of the vegetation at four floodplain transects upstream of the dam. In addition, collections were made from areas surrounding each transect, and the herbarium of Carnegie Museum of Natural History was surveyed for specimens previously collected from the Enlow Fork drainage. This paper describes the Enlow Fork vegetation prior to dam construction, and thus serves as a comparative basis for future studies of the vegetation inhabiting the valley following the completion and operation of the dry dam.

SITE DESCRIPTION

Enlow Fork and Dunkard Fork converge near Majorsville, West Virginia to form Wheeling Creek, which then enters the Ohio River at Wheeling, West Virginia. The Enlow Fork drainage is comprised of an approximately 31,250-acre (12,966-hectare) main stem watershed and Robinson Fork (Robinson Run), a smaller stream which drains approximately 15,750 acres (6,535 hectares) before entering Enlow Fork (Soil Conservation Service 1979). The main stem of Enlow Fork forms the western one-third of the border between Greene and Washington counties in southwestern Pennsylvania (Fig. 1). The lower reach of this medium-sized stream flows westward in an erratic pattern of meanders through a 100- to 200-meter deep valley as it approaches West Virginia and its mouth 1.5 km beyond the Pennsylvania state line (Fig. 1).

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The unglaciated geology of this portion of the Pittsburgh Plateaus Section includes Permian and Pennsylvanian period bedrock of the Washington Formation, Waynesburg Formation, and the Monogahela Group. This bedrock is composed largely of sandstones, shales, occasional limestone, and also deeper coal seams (Berg and Dodge 1981). Soils of the drainage include the Dormont-Culleoka Association and the Dormont-Culleoka-Newark Association, with the latter type occurring on the more productive floodplains (Soil Conservation Service 1979).

The climate of the Wheeling Creek region is characterized as continental and humid, with wide-ranging seasonal temperature variations. The Wheeling-Warwood Dam 12 climatological station lists a normal temperature (degrees F) of 52.8, with a January average of 32.0 and a July average of 74.6 (Soil Conservation Service 1966). Average annual precipitation is 98 cm of which 30% falls as an average of 103 cm of snow. The average growing season is 177 days (Soil Conservation Service 1979).

This section of the eastern deciduous forest has been variously categorized as oak-hickory (Eyre 1980), Appalachian oak (Kuchler 1964), or Cumberland and Allegheny Plateaus mixed mesophytic (Braun 1967). These community types refer to upland and slope forests, whereas the actual Enlow Fork floodplain forest communities more closely match the silver maple-American elm type (Eyre 1980).

Most of this study was confined to the floodplain communities, all of which border or include the riparian shoreline of Enlow Fork Creek. Transect sites are forested except for Transect 1, which is a narrow stream-side forest remnant at the edge of a road and abandoned meadow. Forest canopies are sparse with frequent dense herbaceous

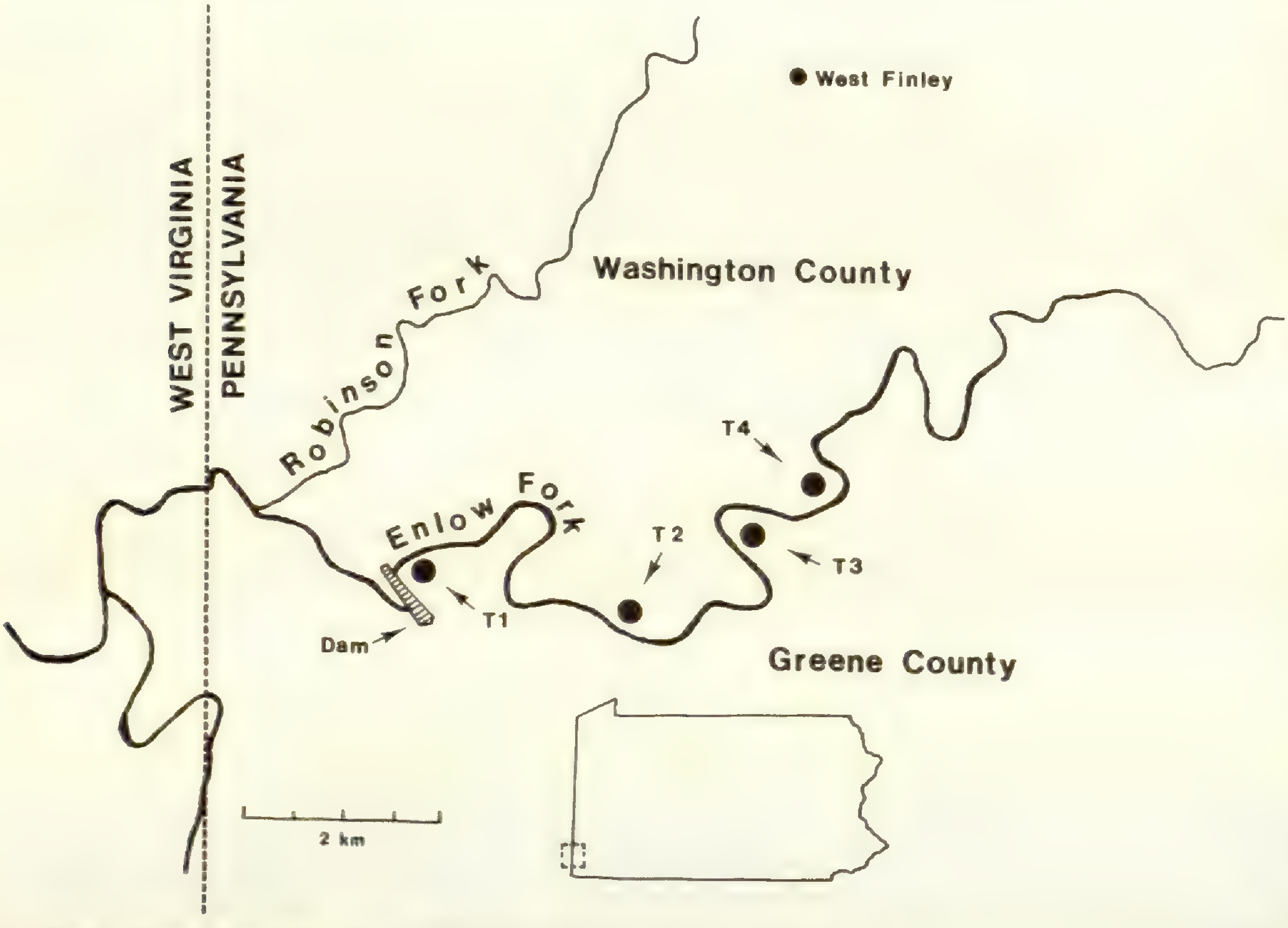

FIG. 1. Map of the Enlow Fork drainage, showing locations of the four study transects (T1, T2, T3, T4).

openings except portions of Transect 2, which has an estiamted 85% closure. Dominant canopy trees for Transects 2, 3, and 4 include mature *Platanus occidentalis, Ulmus americana, U. rubra,* and *Juglans nigra*. The understory is dominated largely by *Acer negundo* and *Aesculus glabra*, but also includes saplings and small trees of canopy species, *Acer saccharum*, and, less frequently, *Liriodendron tulipifera, Robinia pseudoacacia, Carpinus caroliniana,* and species of *Crataegus*. The shrub layer is largely absent in all transects due to robust herbaceous vegetation, but when present includes *Lindera benzoin* and rarely *Corylus americanus*.

The forest communities on the slopes of the Enlow Fork valley are typified by the presence of *Acer saccharum*, which is largely replaced by oaks (*Quercus alba, Q. muhlenbergii,* and *Q. rubra*) in association with *Carya* on the drier upper slopes and plateau uplands. Other slope and upland species include *Liriodendron tulipifera, Prunus serotina* and *Fagus grandifolia. Tsuga canadensis* is uncommon and is limited to cool steep valley sides.

In terms of floristic relationships with other regions, Braun's (1967) inclusion of this area as a type of mixed mesophytic community is more descriptive of the midwestern affinities present in the sub-canopy and herbaceous layers. Species found in the Enlow Fork area, which are less typical elsewhere in Pennsylvania, include *Aesculus glabra, Asimina triloba, Collinsia verna, Jeffersonia diphylla, Solidago curtisii,* and *Trillium sessile*.

History of Land Use

Land use in the entire Wheeling Creek watershed, which includes the Enlow Fork valley, is estimated to be 3% cropland, 15% hayland, 32% pastureland, 40% woodland, and 10% other uses (Soil Conservation Service 1979). In recent years the amount of cropland in the watershed has steadily decreased as farmland is abandoned. The land use history of this area is directly related to regional topography with the more level plateau tops being agricultural fields and pastures interspersed with woodlots. Some of the steeper upland valley sides are used as pastures, especially for sheep, but most of the slopes have remained forested and may rarely include small, old-growth groves of sugar maple (*Acer saccharum*). Most of the forests in the basin have been harvested at least twice.

The richer soils of the Enlow Fork bottomland were utilized by occasional farmsteads until the flood control project purchased these, however, the band of suitable higher floodplain and gentle lower slopes is too narrow for agricultural uses in many places. Active natural gas and oil wells are scattered along the valley bottom as well as on higher plateaus. Narrow and largely unimproved public roads parallel Enlow Fork for its entire lower reach, and the stream is regularly crossed by fords and bridges. Enlow Fork is a popular watershed for outdoor recreation; sportsmen have long taken advantage of the stream's high quality warm-water fishery and large population of white-tailed deer (Soil Conservation Service 1979).

Methods

TRANSECTS. In order to establish a floristic baseline against which to compare future changes in the vegetation of the Enlow Fork floodplain resulting from the dam construction, four transects were studied. These 100 m long by 25 m wide transects were established at various distances upstream of the dam (Table 1), and thus at increasing elevations (262 m, 268 m, 274 m, 277 m), such that each transect was within a different flooding regime. Sites exhibiting representative floodplain vegetation with the least disturbance were selected, although none of the transect sites represent sizeable patches of mature communities. Transects were positioned parallel to Enlow Fork, such that the least disturbed and most homogeneous vegetation was sampled for the 100 m length. However, the sizes of the natural vegetation patches containing Transects 1, 3, and 4 were limited by adjacent community types which were either different or more disturbed, such as abandoned pastures, cropland, or roads. Points along the transects varied from one to 70 meters from the stream bank. Two transects occur in Greene County and two transects are in Washington County. Transects are not permanently marked in the field, but can be re-located using maps deposited in the Carnegie Museum of Natural History herbarium.

From April 1984 to July 1985, repeated collections of plant specimens were made from all transects, mostly by the senior author. All transects were surveyed for species diversity at least once monthly during April, May, June, July, and September; studies of population size and density for the taxa involved were not done. All transect specimens are deposited at the Carnegie Museum of Natural History herbarium (CM).

GENERAL ENLOW FORK FLORA. Plants were also collected from sites within the Enlow Fork drainage, but not on the transects, during all visits to this region. In addition, all previous specimens in the Carnegie Museum of Natural History herbarium from the Enlow Fork area were surveyed for additional taxa not collected during this study. In particular, W. E. Buker collected many plant specimens from this area.

RESULTS AND DISCUSSION

The resulting list of taxa from the Enlow Fork watershed is presented in the checklist at the end of this paper. Transect numbers on which species were found are indicated in parentheses following the taxon name. The total Enlow Fork flora is richer than the flora represented on the transects (Table 1). A total of 82 families of vascular plants are found in the region versus 61 families occurring on transects. In terms of species, slightly over one-half (56%) of those known to grow in the Enlow Fork drainage were collected from the four transects.

Although located on the floodplain, the transects vary from each other in their floristic compositions (Table 1). The number of species found on each varied from 85 (Transect 4) to 129 (Transect 1). The number of families and genera growing on the

TABLE 1. Summary of the numbers of plant families, genera, and species collected in the Enlow Fork drainage.

Transect (County/Distance above dam)	Families	Genera	Species
Transect 1 (Greene Co./0.2 km)	46	99	129
Transect 2 (Washington Co./3.7 km)	40	77	101
Transect 3 (Greene Co./5.9 km)	44	98	123
Transect 4 (Washington Co./7.0 km)	34	71	85
All transects combined	61	152	210
Total watershed flora	82	239	377
% of total flora found on transects	74%	64%	56%

transects also followed this trend with the site furthest downstream (Transect 1) being the most diverse and the site furthest upstream (Transect 4) having the least diversity. Only 40 species (19%) occured on all four transects.

Previous to this study, 141 species of vascular plants were known from the Enlow Fork region (Wherry et al. 1979). The present checklist contains 377 taxa, an increase of 167%. In all over 900 species have been collected in Greene and/or Washington counties (Wherry et al. 1979; Thompson et al. 1989). Fewer than half that number of species (41%) have been collected from the Enlow Fork drainage.

Three species growing on both sides of Enlow Fork, *Allium canadense, Alliaria petiolata,* and *Solidago curtisii,* were not reported in Wherry et al. (1979) as occurring in either Washington or Greene counties. Twenty-three species collected in the Enlow Fork area are new records for Washington County: *Aesculus flava, Amaranthus retroflexus, Blephilia hirsuta, Cardamine hirsuta, Catalpa bignonioides, Cirsium altissimum, Desmodium glutinosum, Eleocharis obtusa, Elymus villosus, Galium mollugo, Hemerocallis fulva, Hibiscus trionum, Juncus effusus, Liriodendron tulipifera, Nasturtium officinale, Penthorum sedoides, Plantago rugelii, Prenanthes alba, Prunella vulgaris, Rosa multiflora, Scrophularia lanceolata, Stachys nuttallii, Veronica americana.*

Collecting in the Enlow Fork drainage yielded 20 species not previously recorded as occurring in Greene County: *Anthemis cotula, Aquilegia canadensis, Bromus racemosus, Chenopodium ambrosioides, Conium maculatum, Digitaria ischaemum, Echinochloa crus-galli, Lamium maculatum, Lysimachia quadrifolia, Melilotus officinalis, Panicum philadelphicum, Plantago major, Populus deltoides, Potentilla recta, Rosa wichuraiana, Rumex obtusifolius, Salix discolor, Solanum carolinense, Toxicodendron radicans, Typha angustifolia.* More complete collection data for these county records are reported in Thompson et al. (1989).

Four species listed as plants of special concern in Pennsylvania (Pennsylvania Department of Environmental Resources 1987) occur in the Enlow Fork area. *Collinsia verna* (Scrophulariaceae), listed as rare in Pennsylvania, was present at all four transects and occurs regularly throughout much of the lower Enlow Fork valley. *Stachys nuttallii* (Lamiaceae) is considered to be endangered in Pennsylvania. This species was not found on any transect nor has it been recently collected, however, the Western Pennsylvania Conservancy is presently aware of one population. *Solidago curtisii* (Asteraceae), previously listed as extirpated in Pennsylvania, was found on three transects in both Washington and Greene counties. *Lithospermum latifolium* (Boraginaceae), which has a tentatively undetermined status on Pennsylvania's rare plant list, was collected in 1946 from the Enlow Fork valley, but no populations are presently known to exist.

CHECKLIST OF ENLOW FORK VASCULAR PLANTS

Numbers in parentheses indicate transects on which that taxon was found. Those taxa not followed by transect numbers occur in the Enlow Fork area, but were not collected on any transect. Nomenclature follows the list prepared by Morris Arboretum (Rhoads and Fogarasi, n.d.) for the Pennsylvania flora database project. The family sequence generally follows that of Wherry et al. (1979). All of the specimens on which this list is based are deposited in the Carnegie Museum of Natural History herbarium (CM).

Polypodiaceae, s.l.: *Adiantum pedatum, Asplenium rhizophyllum, Athyrium thelypterioides* (3), *Cystopteris bulbifera, C. protrusa, Diplazium pycnocarpon, Dryopteris marginalis* (1), *Polypodium virginianum, Polystichum acrostichoides* (1,2), *Thelypteris hexagonoptera, Woodsia obtusa, Woodwardia areolata.*

Ophioglossaceae: *Botrychium dissectum* (2), *B. virginianum.*

Pinaceae: *Tsuga canadensis.*

Typhaceae: *Typha angustifolia.*

Alismataceae: *Sagittaria latifolia* (3).

Poaceae: *Agrostis hyemalis, Bromus racemosus* (1), *Cinna arundinacea* (2,3), *Dactylis glomerata* (1,2,3,4), *Dichanthelium clandestinum* (3), *Digitaria ischaemum* (1), *Echinochloa crus-galli* (1,3), *Elymus riparius, E. villosus* (1,2,3,4), *Festuca obtusa* (1,2,3,4), *F. pratensis* (1,2,3,4), *Glyceria striata, Hystrix patula* (4), *Leersia virginica* (1,3,4), *Muhlenbergia frondosa, M. schreberi* (1,3), *Panicum capillare, P. dichotomiflorum* (1), *P. philadelphicum* (1,3), *Poa cuspidata, P. pratensis* (1,2,3,4), *P. sylvestris, P. trivialis* (2), *Setaria glauca* (1,3), *S. viridis* (1).

Cyperaceae: *Carex amphibola* var. *rigida* (2), *C. blanda, C. communis, C. convoluta, C. gracilescens, C. laevivaginata, C. laxiflora, C. pensylvanica, C. platyphylla, C. prasina, Cyperus esculentus, C. flavescens* (1), *C. strigosus* (1,2,3), *Eleocharis obtusa* (2), *Scirpus tabernaemontani* (2).

Araceae: *Arisaema triphyllum* (2).

Commelinaceae: *Commelina communis* (1,3).

Juncaceae: *Juncus effusus, Luzula multiflora.*

Liliaceae: *Allium canadense* (1,3,4), *Erythronium americanum* (3), *Hemerocallis fulva, Ornithogalum umbellatum, Polygonatum pubescens* (1), *Smilacina racemosa* (3,4), *Trillium erectum* (1,3,4), *T. grandiflorum* (1,3,4), *T. sessile* (3).

Iridaceae: *Sisyrinchium angustifolium* (1).

Salicaceae: *Populus deltoides* (1), *Salix discolor* (1), *S. eriocephala, S. exigua, S. nigra* (1).

Juglandaceae: *Carya cordiformis* (1), *Juglans cinerea, J. nigra* (1,3).

Betulaceae: *Carpinus caroliniana* (3), *Corylus americana* (4).

Fagaceae: *Fagus grandifolia* (3), *Quercus alba, Q. muhlenbergii, Q. rubra* (1,2).

Ulmaceae: *Ulmus americana* (1,2,3,4), *U. rubra* (2,4).

Moraceae: *Maclura pomifera.*

Urticaceae: *Boehmeria cylindrica* (3), *Laportea canadensis* (2,3,4), *Parietaria pensylvanica, Pilea pumila* (1,2,3,4), *Urtica dioica* ssp. *gracilis* (3,4).

Aristolochiaceae: *Aristolochia serpentaria, Asarum canadense.*

Polygonaceae: *Polygonum aviculare* (1), *P. convolvulus, P. erectum, P. hydropiper* (1,2,3), *P. pensylvanicum* (1,3), *P. persicaria* (1,2,3,4), *P. sagittatum* (3), *P. scandens* (1,2,3,4), *P. virginianum* (1,2,3,4), *Rumex acetosella, R. obtusifolius* (1,2).

Chenopodiaceae: *Chenopodium album* (2), *C. ambrosioides* (1).

Amaranthaceae: *Amaranthus retroflexus* (2).

Phytolaccaceae: *Phytolacca americana.*

Portulacaceae: *Claytonia virginica* (1,2,3,4).

Caryophyllaceae: *Cerastium nutans, C. tomentosum, Dianthus armeria, Myosoton aquaticum* (1,3,4), *Paronychia canadensis, Saponaria officinalis* (1), *Silene virginica* (1), *Stellaria graminea* (1,3), *S. media* (1,3,4), *S. pubera.*

Ranunculaceae: *Actaea pachypoda* (2), *Anemone virginiana, Aquilegia canadensis, Clematis virginiana, Delphinium tricorne* (4), *Hepatica nobilis* var. *acuta, H. nobilis* var. *obtusa, Ranunculus abortivus* (1,2,3,4), *R. allegheniensis, R. hispidus* (1,2,3,4), *R. recurvatus, R. septentrionalis, Thalictrum dioicum, T. pubescens* (1,2,3,4), *T. thalictroides.*

Berberidaceae: *Caulophyllum thalictroides, Jeffersonia diphylla* (2), *Podophyllum peltatum* (2,3).

Menispermaceae: *Menispermum canadense.*

Magnoliaceae: *Liriodendron tulipifera* (2).

Annonaceae: *Asimina triloba.*

Lauraceae: *Lindera benzoin* (2,3,4).

Fumariaceae: *Dicentra cucullaria* (2).

Brassicaceae: *Alliaria petiolata* (1,2,3,4), *Arabis laevigata, Barbarea vulgaris* (1,3), *Capsella bursa-pastoris* (1), *Cardamine angustata, C. bulbosa, C. concatenata* (3), *C. diphylla* (2,4), *C. douglassii* (2,4), *C. hirsuta* (1,2,3,4), *C. pensylvanica, C. rotundifolia* (3), *Hesperis matronalis* (1,2,3,4), *Nasturtium officinale* (2), *Rorippa palustris* ssp. *fernaldiana* (1).

Crassulaceae: *Sedum ternatum* (1).

SAXIFRAGACEAE: *Hydrangea aborescens*, *Mitella diphylla*, *Penthorum sedoides* (2), *Ribes cynosbati*, *Saxifraga virginiensis*, *Tiarella cordifolia*.

HAMAMELIDACEAE: *Hamamelis virginiana*.

PLATANACEAE: *Platanus occidentalis* (1,2,3,4).

ROSACEAE: *Agrimonia pubescens* (3,4), *Amelanchier arborea*, *Aruncus dioicus*, *Crategus punctata* (3,4), *Fragaria virginiana* (3), *Geum canadense* (2,3,4), *G. vernum*, *Malus coronaria*, *Physocarpus opulifolius* (2,3), *Potentilla canadensis*, *P. norvegica* (2), *P. recta* (1), *P. simplex*, *Prunus americana*, *P. serotina* (3), *Rosa multiflora*, *R. wichuraiana* (3), *Rubus pugnax* (4), *Spiraea japonica*.

FABACEAE: *Amphicarpaea bracteata* (3), *Cercis canadensis*, *Desmodium glutinosum*, *Melilotus officinalis*, *Robinia pseudoacacia* (1,4), *Senna hebecarpa*, *Trifolium campestre*, *T. pratense* (1,3), *T. repens* (1).

GERANIACEAE: *Geranium maculatum* (3,4), *G. sibiricum* (1,2,3,4), *G. versicolor*.

OXALIDACEAE: *Oxalis grandis*, *O. stricta* (1,3).

RUTACEAE: *Zanthoxylum americanum*.

EUPHORBIACEAE: *Acalypha virginica* var. *rhomboidea* (1,2,3), *Chamaesyce maculata* (1), *Euphorbia commutata*.

LIMNANTHACEAE: *Floerkea proserpinacoides* (1,2,3,4).

ANACARDIACEAE: *Rhus glabra*, *Toxicodendron radicans* (3).

CELASTRACEAE: *Euonymus atropurpureus*.

ACERACEAE: *Acer saccharum* (1,2,3,4), *A. negundo* (1,2,3,4), *A. nigrum*.

HIPPOCASTANACEAE: *Aesculus flava*, *A. glabra* (1,2,3,4).

BALSAMINACEAE: *Impatiens capensis* (1,2,3,4), *I. pallida* (1,2,3,4).

RHAMNACEAE: *Ceanothus americanus*.

VITACEAE: *Parthenocissus quinquefolia* (1,3), *Vitis riparia*, *V. vulpina* (1,4).

TILIACEAE: *Tilia americana*.

MALVACEAE: *Abutilon theophrasti*, *Hibiscus trionum* (1).

HYPERICACEAE: *Hypericum mutilum* (4), *H. punctatum* (1).

VIOLACEAE: *Hybanthus concolor*, *Viola obliqua*, *V. palmata*, *V. pubescens* var. *eriocarpa*, *V. sororia* (1,2,3,4), *V. striata* (1,2,3,4).

THYMELAEACEAE: *Dirca palustris*.

ONAGRACEAE: *Epilobium coloratum* (1,2,3), *Oenothera biennis* (1,3).

ARALIACEAE: *Panax quinquefolius*.

APIACEAE: *Chaerophyllum procumbens* (4), *Conium maculatum* (1,2), *Cryptotaenia canadensis* (1,2,3), *Daucus carota* (1), *Osmorhiza claytoni*, *O. longistylis* (2,4), *Taenidia integerrima*, *Thaspium barbinode* (3), *T. trifoliatum* var. *flavum*.

CORNACEAE: *Cornus alternifolia*, *C. florida*.

PRIMULACEAE: *Lysimachia ciliata* (1,2), *L. quadrifolia*.

GENTIANACEAE: *Sabatia angularis*.

APOCYNACEAE: *Apocynum cannabinum*.

ASCLEPIADACEAE: *Asclepias incarnata*.

CONVOLVULACEAE: *Cuscuta gronovii* (1,2,3,4).

POLEMONIACEAE: *Phlox divaricata* (1,3,4), *P. paniculata* (1,3), *Polemonium reptans* (3,4).

HYDROPHYLLACEAE: *Hydrophyllum appendiculatum* (1), *H. canadense* (2,3,4), *Phacelia purshii* (1).

BORAGINACEAE: *Hackelia virginiana*, *Lithospermum latifolium*, *Mertensia virginica* (1,3,4).

VERBENACEAE: *Verbena hastata* (2,3), *V. urticifolia* (1,2,3,4).

LAMIACEAE: *Blephilia ciliata*, *B. hirsuta* (1,4), *Collinsonia canadensis* (3), *Glechoma hederacea* (1,2,3,4), *Lamium maculatum*, *L. purpureum* (1,2,3,4), *Lycopus americanus*, *L. virginicus* (1,3), *Monarda clinopodia* (1,2,3,4), *M.* × *media*, *Nepeta cataria*, *Prunella vulgaris* (1,3,4), *Scutellaria incana*, *S. lateriflora* (1), *Stachys nuttallii*, *Teucrium canadense* (3,4).

SOLANACEAE: *Datura stramonim*, *Solanum carolinense* (3), *S. nigrum* (1).

SCROPHULARIACEAE: *Collinsia verna* (1,2,3,4), *Mimulus ringens* (2), *Penstemon digitalis*, *Scrophularia lanceolata*, *S. marilandica* (2,3), *Verbascum blattaria* (2), *Veronica americana*, *V. peregrina*, *V. serpyllifolia*.

BIGNONIACEAE: *Catalpa bignonioides* (2).

PLANTAGINACEAE: *Plantago lanceolata* (1), *P. major* (1), *P. rugelii* (3,4), *P. virginica*.

RUBIACEAE: *Galium aparine* (1,2,3,4), *G. asprellum* (1,3,4), *G. mollugo*, *G. triflorum*, *Hedyotis caerulea*, *H. longifolia*, *H. purpurea* var. *ciliolata*.

CAPRIFOLIACEAE: *Sambucus canadensis*, *Symphoricarpos orbiculatus* (3), *Triosteum aurantiacum*, *Viburnum acerifolium*.

VALERIANACEAE: *Valeriana pauciflora* (1,2,3,4), *Valerianella chenopodifolia* (1,2,3,4).

DIPSACACEAE: *Dipsacus fullonum* (1,3).

CUCURBITACEAE: *Sicyos angulatus* (1,2,3,4).

CAMPANULACEAE: *Campanula americana* (2,4), *Lobelia inflata* (3), *L. siphilitica* (1,2,3,4).

ASTERACEAE: *Achillea millefolium* (1), *Ambrosia artemisiifolia* (1), *A. trifida*, *Antennaria parlinii*, *Anthemis cotula*, *Arctium minus* (3,4), *Aster cordifolius* (1,2,4), *A. divaricatus* (2), *A. lateriflorus* (1,2), *A. lowrieanus*, *A. novae-angliae*, *A. pilosus* (1), *A. prenanthoides* (3), *A. puniceus* (1), *A. shortii* (2), *A. simplex* (2), *Bidens cernua* (1,2), *B. frondosa* (3), *B. tripartita* (1,2), *Chrysanthemum leucanthemum* (3), *Cirsium altissimum*, *Conyza canadensis* (3), *Erechtites hieraciifolia*, *Erigeron philadelphicus* (1,3,4), *E. pulchellus* (2), *E. strigosus* (1,2,3), *Eupatorium fistulosum* (1,2), *E. perfoliatum* (1,2,3), *E. purpureum* (3), *E. rugosum* (1,2,3,4), *Galinsoga parviflora* (2), *G. quadriradiata* (1,2,4), *Helenium autumnale* (1,2,3), *Helianthus decapetalus*, *H. microcephalus*, *H. strumosus*, *H. tuberosus*, *Heliopsis helianthoides* (1,3), *Hieracium scabrum*, *Lactuca biennis*, *L. floridana*, *L. saligna*, *L. serriola*, *Polymnia canadensis* (2,4), *Prenanthes alba*, *P. altissima*, *Rudbeckia hirta*, *R. laciniata* (2,4), *Senecio aureus* (3,4), *S. obovatus*, *Solidago bicolor*, *S. caesia* (1,2,3), *S. canadensis* (1,2), *S. curtisii* (1,2,3), *S. flexicaulis* (4), *S. gigantea*, *S. juncea*, *S. nemoralis*, *S. ulmifolia*, *Taraxacum officinale* (1,4), *Tussilago farfara* (3), *Verbesina alternifolia* (1,2,3,4), *Veronia gigantea* (3), *Xanthium strumarium* (1).

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Distribution and Current Status of Three State-Listed Goldenrods (*Solidago:* Asteraceae) in Pennsylvania

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Five taxa of goldenrods (*Solidago:* Asteraceae) currently are officially listed as rare species by the Pennsylvania Department of Environmental Resources (PDER 1987). Three of these taxa are restricted to the central and southwest portions of the state: *Solidago arguta* Aiton subsp. *harrisii* (E. S. Steele) Cusick, *S. erecta* Pursh, and *S. roanensis* T. C. Porter. A survey for populations of these three goldenrods was conducted in 1987 and 1988. This survey had three goals: (1) to determine if these taxa still grew at historic sites, (2) to locate additional populations, and (3) to assess the proper status of these goldenrods in Pennsylvania.

The three taxa are listed below with brief comments on the historic and current distribution of the species, habitats, and taxonomy, including one new combination. Proposed state status and suggestions for management and protection of these species are summarized. Specimen citations are condensed. More complete data on populations of these goldenrods are contained in the rare plant database of the Bureau of Forestry, Pennsylvania Department of Environmental Services, Harrisburg.

Solidago arguta Aiton subsp. **harrisii** (E. S. Steele) Cusick, comb. nov.[1]

Bedford Co: SE-facing shale barrens above Town Creek, NE of Hewitt, 31 Aug 1987, *Cusick 26935* (CM, NY, OS). Fulton Co: SW-facing shale barrens above Sideling Hill Creek, SE of Barnes Gap, 1 Sep 1987, *Cusick 26966* (CM, MICH, MU, NY).

Harris' goldenrod, an endemic of the mid-Appalachian shale barrens of Maryland, Pennsylvania, Virginia, and West Virginia (Keener 1983), was originally described from shale barrens near Cumberland, Maryland, by E. S. Steele (1911). Reports from eastern Kentucky (Braun 1943; Cronquist 1980) are unverified. This taxon is not listed for Pennsylvania in most reference works (Cronquist 1980; Fernald 1950; Gleason & Cronquist 1963; Wherry et al. 1979). It is reported from the commonwealth by Henry (1978) and Wiegman (1979), based upon a 1967 collection from Bedford County (CM, PH).

Two populations of Harris' goldenrod were located in this study, both apparently vigorous and with several hundred individuals. The species grows in calcareous Devonian shales on steep slopes above deeply-entrenched tributaries of the Potomac River. The plants are in full sun or in filtered light under *Juniperus virginiana* L. and *Quercus muhlenbergii* Engelm. The Bedford county site apparently is the same from whence came the 1967 collection.

The habitat for Harris' goldenrod is extremely limited in Pennsylvania. Most of the commonwealth's shale barrens are small in area and depauperate in flora compared with such sites further south. The Sideling Hill barren in Fulton County is a notable exception. This is probably the finest example of a shale barren community in Pennsylvania. The site supports many typical shale barren species including the state-listed *Sedum telephioides* Michx. and *Senecio antennariifolius* Britton. This barren deserves preservation as one of the finest natural areas in Pennsylvania.

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[1] Based on *Solidago harrisii* E. S. Steele, Contr. U.S. Natl. Herb. 13: 369, 1911. Most recent writers have treated this taxon as *Solidago arguta* var. *harrisii* (E. S. Steele) Cronquist.

Solidago erecta Pursh

Franklin Co: SW-facing rocky slope, Rattlesnake Ridge, NW of Cove Gap, 21 Sep 1987, *Cusick 27088* (CM). Fulton Co: SW-facing shalebank, S of Dickeys Mountain, 21 Sep 1987, *Cusick 27103* (CM). Fulton Co: W-facing shalebank, Covalt & Wolf Hollow roads, 21 Sep 1987, *Cusick 27108* (CM, NY).

Slender goldenrod ranges from Georgia and Alabama north through the Appalachians to Ohio and Pennsylvania. It is a common species through much of this region, growing in acidic soils in a variety of open, well-drained situations. Typical habitats include rocky roadbanks and woodland clearings. The historic and modern Pennsylvania records of this species are entirely from shaly banks in the Ridge and Valley Province. Unlike Harris' goldenrod, *Solidago erecta* grows on acidic, rather than calcareous, shales.

There are historic records of *Solidago erecta* from three Pennsylania counties, listed here with dates of last collection and location of specimens: Fayette, 1901 (CM, PH); Franklin, 1961 (CM); Perry, 1927 (CM, PH). Three small populations of this species were found in Franklin and Fulton counties in this survey. Slender goldenrod was not rediscovered in Fayette and Perry counties. There is suitable habitat in those counties, however, and further field work is warranted. My Franklin County specimen cited above is from the general vicinity of the earlier collection from that county.

Solidago erecta indeed is rare in Pennsylvania. Only the above three populations were located despite careful searching along the east slopes of the Alleghenies. The habitat is widespread, nondescript, and often artificial. Two common goldenrods, *Solidago bicolor* L. and *S. hispida* Muhl. ex Willd., also grow in the same habitat as *S. erecta*. These species possibly may be better adapted to exploit disturbed or newly-created shaly situations than *S. erecta*.

Hybridization also may play a role in the rarity of *Solidago erecta* in Pennsylvania. Suspected hybrid populations between *S. erecta* and either *S. bicolor* or *S. hispida* were located in Fulton and Huntingdon counties. Hybrids among these taxa reportedly are frequent near the limits of the range of *S. erecta* (Cronquist 1980; Gleason & Cronquist 1963). Two representative collections of putative hybrid populations are:

Fulton Co: W-facing shalebank, Tonoloway Creek at Johnsons Mill, 21 Sep 1987, *Cusick 27106* (CM). Huntingdon Co: S-facing shalebank, Laurel Run, NW of Pogue, 20 Sep 1988, *Cusick 27837* (CM, MICH, NY).

Solidago hispida, incidentally, is not listed for Pennsylvania in Wherry et al. (1979), despite that species being common throughout central Pennsylvania.

Solidago roanensis T. C. Porter

Somerset Co: cut-over woods on Big Savage Mountain, el. ca. 2500 ft, NE of Pleasant Union, 2 Sep 1987, *Cusick 26980* (CM, NY, OS). Somerset Co: rocky roadbank & woods borders, el. ca. 3070 ft, Forbes State Forest, North Wolf Rock & Vought roads, 2 Sep 1987, *Cusick 26973* (CM).

Mountain goldenrod is frequent at higher elevations in the Southern Appalachians from Pennsylvania south to northern Georgia. Plants in the northern part of this range, including Pennsylvania, have been separated into the poorly-defined var. *monticola* (T. & G.) Fernald. The species is treated here as a single variable entity, following Cronquist (1980). Mountain goldenrod grows in filtered light in a variety of edge habitats such as roadsides and woodland openings. The species is tolerant of moderate disturbance. One of the most vigorous populations of this species found in this survey grows in a recently logged woods.

There are numerous historic collections of *Solidago roanensis* from Bedford and Somerset counties. This species was not rediscovered in Bedford County, where it had last been collected in 1951 (CM). There is no obvious reason for its having disappeared from the area. There is much suitable habitat in western Bedford County and further field work is warranted.

Six extensive populations of *Solidago roanensis* were found in this survey in a limited area of Somerset County. These sites are located on only three 7 ½′ USGS topographic quadrangles. The species is locally frequent in Forbes State Forest near Mount Davis at elevations from ca 2500 to 3100 feet. Two representative collections are cited above.

PENNSYLVANIA STATE STATUS

Under the provisions of the 1987 plant protection laws, *Solidago arguta* subsp. *harrisii* is listed in varietal rank as "Tentatively Undetermined" and both *Solidago erecta* and *S. roanensis* are listed as "Rare" in Pennsylvania (PDER 1987). These terms have no objective criteria and reflect subjective opinions on species status in the commonwealth. The results of the 1987–1988 survey suggest that *Solidago erecta* should be ranked as Endangered and *S. arguta* subsp. *harrisii* as Threatened in Pennsylvania. A state status of Rare seems appropriate for *Solidago roanensis* which, although local, has a number of vigorous populations.

MANAGEMENT AND PRESERVATION

Misguided aesthetics pose the chief threat to the preservation of *Solidago erecta* and *S. roanensis* in Pennsylvania. These species chiefly grow on roadbanks. These habitats should not be "improved" by roadway widening, herbiciding, or summer and fall mowing. Another threat is the planting of crown-vetch (*Coronilla varia* L.) for bank stabilization and supposed beautification. The use of native species, such as goldenrods, for these purposes is not sufficiently appreciated in Pennsylvania and other eastern states.

Preservation of *Solidago roanensis* in Forbes State Forest might be accomplished with little difficulty since many of the populations are along forest roads. Spring mowing of the roadsides would retard the growth of woody species and prevent them from overtopping the goldenrods.

Habitat preservation is the best means to protect the Pennsylvania populations of *Solidago arguta* subsp. *harrisii*. No shale barren communities in the state presently are protected from destruction. Acquisition of at least one of these rare habitats should be a priority of preservationists in Pennsylvania.

ACKNOWLEDGMENTS

My 1987 field work was supported by a Wild Plant Mini-grant from the Pennsylvania Department of Environmental Resources. Various agencies of the Department of Environmental Resources granted permission for me to collect specimens on public lands. I thank the curators of the herbaria at CM, PAC, and PH for their cooperation and assistance. Abbreviations of herbaria are those of Holmgren, Keuken, and Schofield (1981).

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Bartonia No. 56: 13–14, 1990

On the Lectotypification of *Erythronium americanum* Ker (Liliaceae)

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In the first edition of *Species plantarum,* Linnaeus (1753: 305) recognised an unnamed yellow-flowered variety of *Erythronium dens-canis* L. citing as its basis a polynomial proposed by Gronovius (1743: 151): *Erythronium foliis ovato-oblongis glabris nigro maculatis*. That name was based on a plant from Virginia collected by John Clayton (*691*, BM!). When Ker (1808: 1113) proposed *E. americanum* he cited the same polynomial in synonymy, calling attention to both editions of Gronovius' *Flora Virginica* (1743: 151, 1762: 51) as well as Colden (1749: 110). In addition he stated that he had seen a Clayton specimen in the Banks herbarium (BM). He included a description and illustration of the plant and finally mentioned two garden specimens sent to him, one by George Loddiges of Hackney, and another by William Salisbury from the Botanic Garden at Brompton. These garden specimens are apparently no longer extant.

Two syntypes are currently available, Ker's published illustration and *Clayton 691*. Parks and Hardin (1963: 245) considered the species to have been "described vaguely by Ker" and considered his circumscription as "problematical when one realises that he described the species, *E. americanum*, from plants grown in England, transplanted from an unknown area in the United States." We believe that *Clayton 691* (BM) is the more reliable of the available syntypes and hereby designate it as the lectotype.

The Clayton specimen, which bears both a mature flower and fruits, can be readily identified as *Erythronium americanum* subsp. *americanum* using the key of Parks and Hardin (1963). At that time these authors (p. 251) listed the type as "Unknown." This can now be amended.

ACKNOWLEDGEMENTS

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Bartonia No. 56: 15–16, 1990

The Neotypification of *Arum dracontium* L. (Araceae)

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When Linnaeus (1753: 964) proposed *Arum dracontium*, he took his phrase name from van Royen (1740: 7) modifying it from *Arum foliis palmatis, foliolis lanceolatis integerrimis, spatham spadice clavato breviorem superantibus* to *Arum foliis pedatis; foliolis lanceolatis integerrimis superantibus spatham spadice brefiorem*. Even in making the slight change from "*foliis palmatis*" to "*foliis pedatis*," he could not have had in mind the specimen he had before him in 1752 when he was preparing the text: *Clayton 811* (1079.1, LINN!). An examination of *Clayton 811* (BM!, LINN!) shows that it is *Arum triphyllum* L., better known today as *Arisaema triphyllum* (L.) Schott in Schott & Endl., Metalemata Bot. 19. 1832. Clearly, the trifoliolate Clayton specimen, which has a spathe shorter than the spadix does not correspond with Linnaeus' nomen specificum legitimum.

Searches by Jarvis and Dr. J. F. Veldkamp have failed to locate any specimen in the van Royen herbarium at Leiden (L) of *Arum dracontium* that dates from the pre-1740 era. The one sheet now in the collection (898,88-26) is a later addition, and on its cover is a note: "Royen–not type material of Linnaean epithet." This sheet cannot be regarded as a potential lectotype.

The identity of the Hermann (1687: 60) polynomial cited in synonymy, *Arum polyphyllum Dracunculus & Serpentaria dictum, caule non maculato, minus & humilius*, is uncertain. It might apply to *Arisaema dracontium* as circumscribed in modern floras, but without an illustration (and no Hermann material which can be correlated with this publication is known to exist), it is impossible to determine the basis of Hermann's name.

Linnaeus also described an unnamed variety based on a polynomial and illustration from Plukenet (1694, 1696). Plukenet's *Arum, s. Arisarum Virginianum, Dracontii foliis, pene viridi, longo, acuminato* and illustration (t. 271, f. 1) is of the plant known essentially without interruption since 1753 as *Arum dracontium* or *Arisaema dracontium* (L.) Schott in Schott & Endl., Matelemata Bot. 19. 1832. We have confirmed the identity of the illustrated plant by examining its typotype (H.S. 95: 106) in the Sloane herbarium (BM). The Plukenet illustration is also the holotype of *Arisaema plukenetii* Blume, Rumphia 1: 110. 1836, the only synonym of *Arisaema dracontium*.

The van Royen (1740) polynomial, and that of Linnaeus (1753), applies solely to *Arisaema dracontium* as here typified and not to *A. triphyllum*. Even though Linnaeus incorrectly identified and annotated a Clayton specimen of *A. triphyllum* as *A. dracontium*, it is impossible to consider it a potential type as it does not correspond with the protologue. Without other authentic material, and to preserve the application of *A. dracontium* in its present sense, we hereby neotypify the name of the only extant element Linnaeus examined, the Plukenet figure:

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Arum dracontium Linnaeus, Sp. pl. 2: 964. 1753. NT.: Plukenet, Phytogr. t. 271, f. 1. 1694. (Typotype: H.S. 95: 106, BM-SL!).

ACKNOWLEDGMENTS

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VAN ROYEN, A. 1740. Florae Leydensis prodromus, exhibens plantas quae in horto academico Lugduno-Batavo aluntur. Published by the author, Leiden.

Bartonia No. 56: 17–18, 1990

On the Typification of *Bignonia catalpa* L. (Bignoniaceae)

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In the first edition of *Species plantarum,* Linnaeus (1753: 622) proposed *Bignonia catalpa* with a new diagnosis, and cited three synonyms. The first was a polynomial previously proposed in his *Hortus cliffortianus* (1738: 317) which was also cited in van Royen's *Florae leydensis* (1740: 289). The second polynomial was taken from Catesby (1730: 49) and a third from Kaempfer (1712: 841). No specimens of *B. catalpa* are now in the Clifford herbarium at BM. There is a sheet (776.1, LINN!) in the Linnaean Herbarium which bears the annotation "Bignonia 1 Catalpa" in Linnaeus' hand and which appears to have been in his possession in 1753. However, it conflicts with Linnaeus' diagnosis ("foliis simplicibus cordatis") and hence could not have been the basis for it. It is a specimen of *Catalpa longissima* (Jacq.) Dum. We have not been able to locate any other possible syntype specimens.

Kaempfer's plant is the native Chinese species *Catalpa ovata* D. Don, which he found growing in cultivation in Japan. No voucher for the illustration has been found in his collection in the Sloane herbarium (BM). However, Catesby's plant, as noted by Howard and Staples (1983: 520), is the plant to which Linnaeus' name has generally been applied. Voucher material supporting Catesby's illustration is in the Sloane Herbarium (212:61 and 232:51, BM-SL!). Both specimens are badly damaged, though the former had flowers at one time. We therefore choose *Bignonia urucu foliis, flore sordide albo,* Catesby, Nat. Hist. Carolina 1: t. 49. 1730 as the lectotype of *Bignonia catalpa* L.

It would appear that most authors have believed that Walter (1788: 64) proposed a valid substitute name for *Bignonia catalpa* when he established *Catalpa bignonioides:*

> 12. CATALPA. *Cor.* monopetalo, campanulata. *Cor.*
> 5-phyllus. *Rudimenta* tria staminum.
> *bignonioides* 1. arbor. fol. cordatis.

As Walter makes no mention of the Linnaean name, his genus and species must be regarded as new. A specimen of *C. bignonioides* is preserved in the Walter herbarium (f. 28, BM-SL!; see photograph in Rembert 1980), and we take this to be the holotype.

Paclt's (1947) indication of missing material in the Clifford herbarium (BM) as the type of this name is clearly erroneous.

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Bartonia No. 56: 19, 1990

On the Typification of *Bidens nivea* L. (Asteraceae)

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Bidens nivea Linnaeus, Sp. Pl. 2: 833. 1753. Lectotype: Dillenius, Hort. Eltham. t. 47, f. 55, n. 3. 1732.

In his revision of *Melanthera* Rohr, Parks (1973) designated an illustration from Dillenius (t. 47, f. 55. 1732) as the lectotype of *Bidens nivea* L. (= *Melanthera nivea* (L.) Small). Unfortunately, the plate as a whole is not an eligible syntype as Linnaeus cited it under one of two unnamed varieties. However, Linnaeus did cite a portion of this plate, the representation of a simple leaf (n. 3), as illustrating a synonym of the nominative variety, *Ceratocephalus foliis cordatis s. triangularibus, flore albo* (Vaillant 1720: 327).

Typifying the name on the illustration of a single leaf is far from desirable, but there appears to be no other option as it is the only available syntype. The specimen in the Linnaean Herbarium (975.13, LINN!) annotated "nivea" by Linnaeus was received from Patrick Browne in 1758 and is apparently *Melanthera aspera* Jacq. (see Parks 1973: 170). A duplicate of this collection reached the herbarium of Bergius from Linnaeus and is at SBT(!). We have been unable to trace any relevant specimens in the herbarium at Leiden (L) associated with the van Royen (1740) name which Linnaeus (1753) also cited. A second Dillenius plate, (t. 46, f. 54) is cited under a second unnamed variety and therefore it, too, is not an eligible syntype. Linnaeus' varieties segregate what are now considered leaf morphs of a single taxon, *Melanthera nivea*. The body of *t. 47, f. 55* represents the lobed-leaf form of the species (Nicolson, 1981).

We formally restrict Parks' choice of lectotype to Dillenius' t. 47, f. 55, n. 3.

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Bartonia No. 56: 20–22, 1990

Solander, Dryander, or Aiton: Who is the Author of *Clematis ochroleuca* and What is its Type?

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In an article on the colonial Maryland plants in an unpublished Solander manuscript (Reveal 1985), arguments were put forth supporting Aiton as the author of the new names and combinations in his three-volume *Hortus kewensis* published in 1789. There the difficulties in determining the roles of Daniel C. Solander (1733–1782) and Jonas C. Dryander (1748–1810) were discussed. The manuscript of the *Hortus* apparently was written by both men, with Dryander often editing Solander's text for the first two volumes after Solander died (Britten 1912). It is not my point to reaffirm my conclusion that only Aiton should be credited with the names in his own work, although it is clear he had little to do with the actual scientific merit of the publication, but to present a single case where the roles of Solander and Dryander are so entangled as to prevent any definitive statement as to the attribution of a given name to either Solander or Dryander.

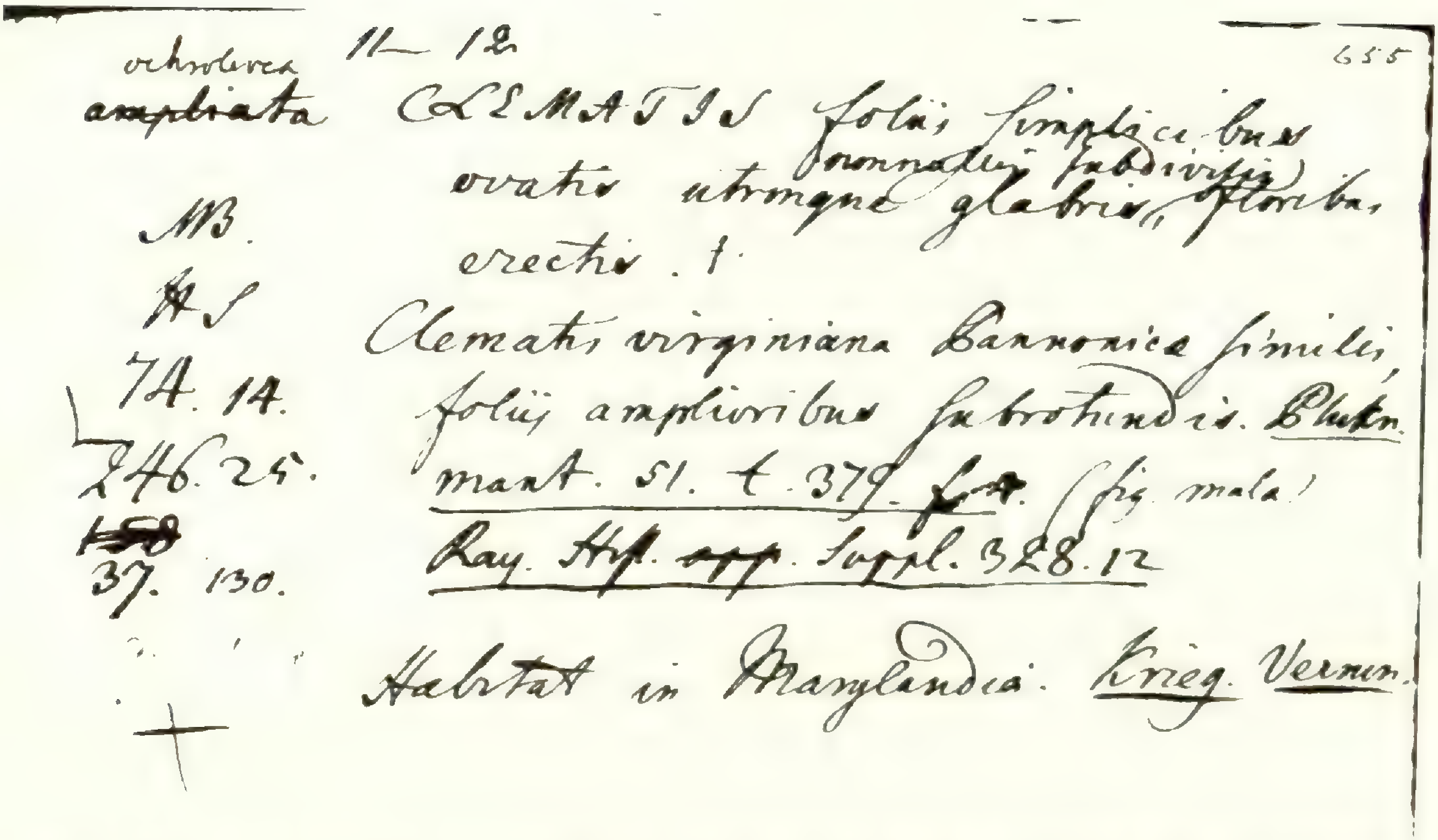
The name in question is *Clematis ochroleuca* Aiton, Hort. Kew. 2: 260. 1789. The full text is as follows:

ochroleuca 12. C. foliis simplicibus ovatis pubescentibus integerrimis, floribus erectis.
Clematis erecta humilis non ramosa, foliis subrotundis, flore unico ochroleuco. *Pluk. mant.* 51. *t.* 379. *f.* 5.
Yellow-flower'd Virgin's Bower.
Nat. of North America.
Cult. 1767, by Mr. James Gordon.
Fl. June and July. H.♃.

What was in Solander's slip catalogue, however, is rather different (Fig. 1). There it can be seen that Dryander altered Solander's epithet from *ampliata* to *ochroleuca* and maintained only a portion of Solander's diagnosis: *CLEMATIS foliis simplicibus ovatis utrinque glabris, nonuliis subdivisis, floribus erectis* was shortened with only *Clematis foliis simplicibus ovatis* and *floribus erectis* remaining. Dryander added *pubescentibus integerrimis* to the leaf features. Solander cited Plukenet's (1700: 51) *Clematis virginiana Pannonicae similis* and its supporting figure (Phytogr. t. 379, f. 4. 1705) while Dryander cited Plukenet's *Clematis erect humilis non ramosa* and the adjoining figure (f. 5). Ray (1704) was deleted entirely.

Reveal et al. (1987) and Essig and Jarvis (1989) associated *Clematis Virginiana Pannonicae similis, foliis amplioribus subrotundis* with *C. ochroleuca*, although the Plukenet figure was cited by Linnaeus as a syntype of *Clematis virginiana* L., Cent. 1: 15. 1755. The specimens of "*C. ampliata*" cited by Solander in his slip catalogue (Fig. 1) were gathered by Krieg and Vernon in Maryland and are *C. ochroleuca* (Brown et al. 1987). The WB at the top of the list stands for William Bartram whose specimen of *C. ochroleuca* is still extant (BM!). Thus Solander recognized *C. ochroleuca* as a new species and associated it with an illustration that he regarded as bad ("mala").

So, whose name is this? Krok (1925) attributed it to Solander, but Solander's actual epithet was *ampliata;* Dryander proposed *ochroleuca*. Solander cited one Plukenet il-



ochroleuca
~~ampliata~~ 11 — 12. 655

CLEMATIS foliis simplicibus ovatis utrinque nonnullis subdivisis glabris, floribus erectis. †

Clematis virginiana Pannonicae similis, foliis amplioribus subrotundis. Pluk. mant. 51. t. 379. f. 5. (fig. mala)

Ray. Hist. ~~app.~~ Suppl. 328. 12

Habitat in Marylandia. Krieg. Vernon.

MB.
HS
74. 14.
246. 25.
~~158~~
37. 130.

FIG. 1. Entry in the Solander slip catalogue for *Clematis ampliata* with alterations added by Dryander.

lustration and likely examined the typotype (H.S. 93: 103, BM-SL!) but Dryander substituted another figure and he may or may not have examined its supporting specimens (H.S. 93:104, BM-SL!). Should the author of *C. ochroleuca* be Solander ex Dryander in Aiton, or Dryander in Aiton, or just Aiton? Where does one draw the line between what Solander did and what Dryander did to his efforts? More than anything else, this points out the dangers in attempting to attribute authorships to anyone but Aiton in this particular work.

The question of authorship relates, in part, to what should be considered authentic material for purposes of lectotypifing *Clematis ochroleuca*. The only elements cited in the original publication were a Plukenet figure and a reference to the gardener who had grown the plant as early as 1767. However, Solander annotated specimens and recorded them in both his slip catalogue now preserved in the Library of the Department of Botany (BM) and made indirect references to them in an unpublished manuscript (Reveal 1985). In this instance, I feel that it is impossible to consider the Bartram, Krieg and Vernon specimens seen and/or annotated by Solander as authentic material insofar as the final publication is concerned because one cannot demonstrate that Aiton (or even Dryander) examined any of these specimens.

Accordingly, the lectotype of *Clematis ochroleuca* Aiton is the Plukenet figure cited by Aiton: *Phytogr*. t. 379, f. 5. 1705. The typotype is at H.S. 93: 104 (BM-SL).

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Aster depauperatus: A Midwestern Migrant on Eastern Serpentine Barrens?

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Serpentine outcrops throughout the world are known for their distinctive floras and unusual number of endemic species (Brooks 1987). Serpentine outcrops in southeastern Pennsylvania and adjacent Maryland have a distinctive flora, but have few endemic taxa. *Cerastium arvense* L. var. *villosissimum* Pennell which is restricted to a few Pennsylvania serpentine barrens near Octoraro Creek in Chester County, has features that could justify its distinction as a species from the widespread *Cerastium arvense,* e.g., larger flowers, prostrate form, and long silvery pubescense in late summer. Nevertheless, it is considered to be a variety (Pennell 1930). *Aster depauperatus* (Porter) Fern. is the only species that is deemed by authors of regional floras (e.g., Fernald 1950; Gleason and Cronquist 1963; Stone 1945) to be a species unique to Pennsylvania–Maryland serpentine barrens. However it recently has been discovered in North Carolina (Levy and Wilbur 1990), and, in addition, these eastern North American plants may actually be disjunct populations of *Aster parviceps* (Burgess) Mackenzie and Bush, which is endemic to Illinois, Missouri, and Iowa.

Fernald (1908) noted the possible identity of the two species. He called the serpentine plant *Aster depauperatus* and considered it as represented in "rich soil westward . . . by var. *parviceps* (Burgess) Br. and Brown Ill. Flora." However, Pennell (1913) considered the serpentine plant to be a species distinct from the midwestern aster because the plant is "slender, its stem smooth or nearly so, its stem-leaves linear, those of the branches minute and mostly appressed, its heads slightly smaller . . . while quite significant is the wide break in range between the two."

Both taxa are grouped in section Porteriani Rydb. which also includes *Aster pilosus* Willd. as well as *A. porteri* A. Gray. Various nomenclatural classifications have been published for this section (see Jones 1980; Jones 1984; Semple and Chmielewski 1985; Jones 1989); most consider *A. depauperatus* and *A. parviceps* to be separate taxa. In this paper I suggest that these two taxa are disjunct populations of the same species. I raise this question not to discuss the systematics of the genus *Aster,* but to focus attention on the origin and history of the serpentine flora of the southeastern Pennsylvania region.

Published descriptions of characteristics that distinguish the two species are listed in Table 1. Both species possess turbinate involucres that are approximately 4 mm long, subulate stem and branch leaves, and ray flowers that are 4 mm long. Characteristics that separate the two species are pilosity, height, number of heads, panicle branching, and number of flowers per head. *Aster parviceps* is also stated to be usually bushy.

Aster parviceps occurs in prairies and dry open sites (Fernald 1950; Jones 1989). *Aster depauperatus* grows on serpentine barrens in Pennsylvania and Maryland, and was recently found on diabase glades in North Carolina (Levy and Wilbur 1990). Serpentine barrens have very infertile shallow soil with high levels of magnesium. Species on these barrens that also grow on other sites are stunted in comparison with their growth on more fertile soils. Characters resulting from impoverished growing conditions should not be used to identify a species; yet these characters are difficult to identify when a plant is confined to a infertile habitat.

In order to determine if the characteristics that distinguish *Aster parviceps* from *Aster depauperatus* are independent of the environment in which they are grown, I collected seeds from *Aster depauperatus* growing on Brinton's Quarry, a serpentine barren in Chester County, Pennsylvania, and cultivated them in a garden of non-serpentine loam. Six plants were harvested, pressed, and dried. One of these plants was deposited as a voucher in the herbarium of the Academy of Natural Sciences in Philadelphia.

I borrowed *Aster parviceps* specimens from the herbarium of the Missouri Botanical Garden. Features that are indicated as diagnostic for the two *Aster* species in the descriptions listed in Table 1 were measured on these specimens and on plants of *Aster depauperatus* cultivated in non-serpentine loam. Similar measurements were made of parent *Aster depauperatus* plants from Brinton's Quarry, and *A. depauperatus* plants collected from another serpentine barren in Goshenville.

Similar measurements were recorded for specimens of *Aster pilosus* in the herbarium of the Academy of Natural Sciences of Philadelphia from non-serpentine sites, and for *Aster pilosus* plants collected from serpentine sites. One set of plants was collected haphazardly from disturbed areas of four different barrens. The other set of plants represented a serpentine ecotype from Staten Island serpentine outcrops (Hart 1980).

Aster pilosus was studied for two reasons. It is a weedy species that occurs on both serpentine and non-serpentine sites. The measurements of this species would demonstrate the differences that can be found within a taxon deemed to be one species and how the characteristics are affected by growth on serpentine soils. The second reason for including *Aster pilosus* was that examination of herbarium specimens of *Aster depauperatus* indicated that it is often confused with *Aster pilosus* var. *demotus* S. F. Blake. *Aster depauperatus* was mistakenly cited as occurring in West Virginia by both Gleason and Cronquist (1963) and by Fernald (1950) because of an erroneous identification of *Aster pilosus* var. *demotus* by Millspaugh (Strausbaugh and Core 1978). In-

TABLE 1. Published descriptions of characters which distinguish between *Aster depauperatus* and *Aster parviceps*.

Reference	*Aster depauperatus*	*Aster parviceps*
Britton and Brown 1898	glabrous, very slender, 6″–12″ high; turbinate involucre 2″ high, rays 2″ long	more or less pilose; stem erect, 1½–2′ high, usually bushy; heads numerous, crowded, involucre ½–2″ high, rays 20–23, 2″ long
Fernald 1908	slender stem, tiny rameal leaves; turbinate, not campanulate or hemispherical involucre	stout plant with densely white-villous stems and broader leaves, but with heads as in the typical form of *A. depauperatus*
Fernald 1950	glabrous, slender stem, panicle more diffuse (than *parviceps*); flowering branches remote, involucre 3.5–4 mm high, disk florets 6–10	stems pilose, 3–7.5 dm high, paniculate branched, heads subapproximate, involucre 4–4.5 mm high, disk-corollas 6–12, ligules 10–12, 4–5 mm long
Gleason and Cronquist 1963	glabrous, 1–4 dm, heads 16–32 flowered, rays 2–3 more than disk	hirsute to glabrous, 3–8 dm, 18–32 flowered, 12–18 rays, width 4 mm, 4–10 more than disk

consistencies in reports of *Aster depauperatus* presence on various barrens may be due to confused identities.

All plants collected from the field were pressed and dried before measurements were taken.

RESULTS

ASTER DEPAUPERATUS AND *ASTER PARVICEPS*. Characteristics of *Aster depauperatus* that varied with growth conditions include height, number of capitula (flowering heads) per plant, and the length of the stem leaf just below the capitulum (Table 2). Height of cultivated *A. depauperatus* was almost twice the height of the parent plants on Brinton's Quarry. Cultivated *A. depauperatus* was also significantly taller than *A. parviceps* collected from natural sites ($t = 2.9$, $p < 0.05$). The height of *A. parviceps* was within the range of variation of *A. depauperatus* from Brinton's Quarry.

The mean number of capitula per plant borne by the cultivated asters was 381.7 in comparison with 56.6 capitula per plant for the parent plants on Brinton's Quarry and 47.4 capitula per plant for asters from Goshenville barren. The cultivated *A. depauperatus* plants had significantly more capitula per plant than *A. parviceps* plants ($t = 3.5$, $p < 0.05$).

The length of the leaf below the capitulum was very similar for cultivated *A. depauperatus* and *A. parviceps* (3.5 and 3.8 mm, respectively). In contrast, the mean length of the stem leaf below the capitulum for the Goshenville and Brinton asters was 2.3 and 2.1 mm, respectively. The mean stem leaf length of the serpentine-grown Brinton aster was significantly less than the stem leaf length of their cultivated progeny ($t = 2.8$, $p < 0.05$).

Aster parviceps was described as bushy. Number of branches longer than 5 cm was used as a measure of bushiness. There was no consistent pattern of bushiness. *Aster parviceps* with a mean of 9.4 branches longer than 5 cm was not bushier than *A. depauperatus* from the Goshenville barren or from Brinton's Quarry with mean branch numbers of 10.9 and 13.6, respectively.

Characteristics that did not vary with soil conditions included fraction of glabrous stems, number of flowers per capitulum, and length of ray flowers. *A. depaupteratus* plants were glabrous, whereas *A. parviceps* showed variability in this character. However, since both pubescent and glabrous individuals are found among *A. parviceps*, this species cannot be distinguished from *A. depauperatus* by pubescence.

The mean number of flowers per capitulum of *A. depauperatus* from Brinton's Quarry was the same, regardless of the soil in which the plant grew. Both *A. depauperatus* from Goshenville barren and *A. parviceps* had significantly more flowers per head ($t = 3.2$, $p < 0.05$) than asters from Brinton's Quarry, but they were not significantly different from each other in this character ($t = 2.0$, $p > 0.05$).

Mean length of ray flowers of barren-grown *A. depauperatus* populations (3.4 and 3.3 mm) was similar to *A. parviceps* (3.5). The non-serpentine cultivated *A. depauperatus* had ray flowers with mean length of 3.0; these were significantly shorter than *A. parviceps* rays ($t = 2.7$, $p < 0.05$).

Both taxa had turbinate involucres. Although the Brinton populations were not measured, examination of these populations, as well as *Aster depauperatus* herbarium specimens at the Academy of Natural Sciences, showed that this was a consistent character for these two species.

ASTER PILOSUS. *Aster pilosus* var. *pilosus* and *Aster pilosus* var. *demotus* are distin-

TABLE 2. Means of characters of *Aster depauperatus* from serpentine sites and a non-serpentine garden, *Aster parviceps* from non-serpentine sites, and *Aster pilosus* from serpentine and non-serpentine sites. Standard errors are in parentheses. Number of plants in each category are in brackets. NM = not measured.

Species	Fraction glabrous plants	Height stem (cm)	Bract width ⅔ from tip (mm)*	Number flowers per capitulum	Ray length (mm)	Number capitula per plant	Length leaf below capitulum (mm)	Number branches >5 cm
A. depauperatus East Goshen barren	11/11	32.9 (2.2)	2.3 (.1)	19.1 (1.3)	3.4 (.2)	47.4 (6.6)	2.3 (.05)	10.9 (3.1)
A. depauperatus Brinton barren [8]	8/8	47.4 (4.7)	NM NM	16.5 (1.4)	3.3 (.2)	56.6 (12.4)	2.1 (.1)	13.6 (1.0)
A. depauperatus Brinton seed grown in non-serpentine [6]	6/6	94.3 (14.6)	NM NM	16.5 (1.3)	3.0 (.2)	381.7 (68.5)	3.5 (.5)	16.3 (3.5)
A. parviceps Missouri and Illinois [28]	7/28	50.8 (3.9)	2.3 (.1)	**21.0 (4.3)	3.5 (.1)	273.6 (65.8)	3.8 (.4)	9.4 (1.0)
A. pilosus var. *demotus* Pennsylvania [15]	glabrous by definition	58.9 (3.5)	4.1 (.2)	**35.8 (1.0)	4.7 (.2)	101.8 (12.4)	3.6 (.5)	7.1 (1.2)
A. pilosus var. *pilosus*, Pennsylvania [15]	pilose by definition	65.2 (4.2)	4.8 (.3)	NM	5.0 (.2)	123.3 (21.0)	7.7 (.5)	12.7 (1.7)
A. pilosus disturbed Pa. serpentine sites [30]	14/30	78.9 (4.3)	NM	34.5 (1.0)	5.0 (.1)	71.3 (5.3)	5.6 (.1)	11.4 (0.6)
A. pilosus var. *demotus* Staten Island serpentine ecotype [8]	8/8	50.8 (4.7)	NM	40.8 (2.3)	5.2 (.2)	78.4 (15.8)	4.6 (.2)	18.4 (2.2)

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* Measure of involucre shape. Turbinate involucres are narrower at ⅔ of the length from the tip. Hemispheric involucres are as wide as they are long. Involucre height is approximately 4 mm for all asters measured.

** Number flowers per capitulum was difficult to measure accurately in most of the herbarium specimens due to their age and desiccation and my desire not to mutilate the plants. Six plants each were measured for *A. parviceps* and *A. pilosus* var. *demotus* collections and no *A. pilosus* var. *pilosus* were measured.

guished only by lack of pubescence on var. *demotus*. *A. pilosus* var. *pilosus* is more likely to be found in disturbed habitats than var. *demotus* (Hart 1976). Of *Aster pilosus* from disturbed serpentine sites, 46.7% of the plants were glabrous. The serpentine ecotype from Staten Island is consistently glabrous.

Height was highly variable within all collections measured, but was not related to growth in serpentine soil. Both the tallest and the shortest populations are from serpentine sites. *Aster pilosus* from disturbed serpentine sites was significantly taller than the other collections measured ($t = 4.4$, $p < 0.05$). My observations of *Aster pilosus* var. *pilosus* on disturbed sites in the region are that the plants commonly exceed 100 cm. I suspect that there was a bias towards collecting short plants for herbarium specimens. Bushiness, as indicated by number of branches that exceeded 5 cm length, also showed no relationship to growth on serpentine sites.

Characters that varied with growth conditions include number of capitula per plant and length of leaf below the capitulum. The mean number of capitula per plant of *A. pilosus* from non-serpentine sites showed no significant difference, regardless of variety (101.8 for *demotus* and 123.3 for *pilosus*). There was no significant difference in the mean number of capitula per plant between *A. pilosus* grown in Pennsylvania serpentine soil and plants grown in Staten Island serpentine soil (71.3 and 78.4, respectively), regardless of the variety. However, these serpentine-grown plants had significantly fewer capitula per plant than *Aster pilosus* from non-serpentine sites.

The length of leaf below the capitulum was greater for var. *pilosus* (7.7 mm) than for var. *demotus* from non-serpentine sites (3.6 mm) and for both populations from serpentine sites (4.6 mm).

Characters that did not vary within *Aster pilosus* included length of ray flowers and number of flowers per capitulum. *Aster pilosus* var. *demotus* can be distinguished from *Aster depauperatus* by its involucre which is hemispheric rather than turbinate in shape. It also has approximately twice the number of flowers per capitulum as *Aster depauperatus*. Ray flowers of *A. depauperatus* are less than 4.0 mm long whereas ray flowers of *Aster pilosus* are longer than 4.0 mm.

Other characteristics of *Aster pilosus* that were measured were highly variable, but could not always be related to growth on serpentine.

CONCLUSION

The putative differences between *A. depauperatus* and *A. parviceps* disappear when *A. depauperatus* is grown on a more fertile site than its native serpentine site. The serpentine native does differ from *A. parviceps* in being consistently, instead of variably, pubescent.

Since the characters that distinguish *Aster depauperatus* from *Aster parviceps* do not hold constant when *A. depauperatus* is grown on a more fertile soil than serpentine, *Aster depauperatus* could represent a disjunct serpentine-tolerant population of midwestern *Aster parviceps* on eastern serpentine barrens. The possibility of a disjunct origin is given more credence by the discovery of *Aster depauperatus* on diabase glades in north central North Carolina (Levy and Wilbur 1990). Occurrences of this species in both North Carolina and southeastern Pennsylvania are more likely to be due to past migrations of formerly widespread taxa than to independent evolution on one regionally restricted substrate and subsequent migration to another.

The diploid chromosome number for the North Carolina plants was $2n = 16$ (Levy and Wilbur 1990). Diploid chromosome numbers reported for serpentine *A. depau-*

peratus and *A. parviceps* are also 2n = 16, although there is one tetraploid number reported for *A. parviceps* (Semple and Chmielewski 1985; Jones 1980). In contrast, reported diploid chromosome numbers for *Aster pilosus* range from 32 to 48 (Semple and Chmielewski 1985; Jones 1980).

Aster parviceps was not available for cultivation on serpentine sites, breeding experiments, and other studies that might confirm that the two taxa were the same. However, other midwestern prairie species are found on eastern serpentine barrens, e.g. *Bouteloua curtipendula* (Michx.) Torrey and *Asclepias verticillata* L. They may date from a more easterly range of prairie vegetation during the xerothermic period or they may have migrated earlier along the southern edge of the melting terminal moraine. *Aster depauperatus* may be another species with a population left stranded on an eastern barren site far from its midwestern range.

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Pennsylvania Records of Large-Leaved Waterleaf (*Hydrophyllum macrophyllum*, Hydrophyllaceae)

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On April 20, 1986 we discovered a population of *Hydrophyllum macrophyllum* Nutt. in southwestern Franklin County, Pennsylvania, within one kilometer of the border of Maryland. We verified the determination on June 8, 1986 when the plants were in flower, and later learned that D. Daniel Boone, Coordinator/Botanist for the Maryland Natural Heritage Program, had tentatively identified the species from vegetative rosettes at this site on May 2, 1981. The population spans approximately four hectares and comprises three subpopulations of about 50, 500, and 1500 rosettes.

We collected casual phenological data from the population. They indicate expansion of basal leaves in March and April, bolting and floral development in May, anthesis from late May to early June, and leaf senescence plus fruiting during June or July. The dates of anthesis that we observed agree with the months of flowering (May and June) reported in other parts of the range of the species (Brown and Brown 1984; Fernald 1950; Gleason and Cronquist 1963; Strausbaugh and Core 1977; Westmoreland 1981, Wofford 1989).

All of the corollas that we saw were white. This observation agrees with the description of *Hydrophyllum macrophyllum* in West Virginia (Strausbaugh and Core 1977) but differs from the "purple-pinkish" corollas reported from Illinois (Westmoreland 1981). Within the total range of the species, the corollas are reported to be "white . . . (occasional pink)" (Beckmann 1979) and "white or pinkish" (Gleason and Cronquist 1963).

Hydrophyllum macrophyllum occurs in rich, moist woods from West Virginia and western Virginia to Illinois, Georgia, and Alabama (Fernald 1950; Gleason and Cronquist 1963). The northeastern limit of the species is represented by five populations: our new record in Pennsylvania; three in Washington County, Maryland; and one in Jefferson County, West Virginia. Together these five populations are disjunct by about 100, 200, and 400 kilometers from the nearest respective populations in Maryland (Garrett County: Brown and Brown 1984), West Virginia (Taylor County: Strausbaugh and Core 1977), and Virginia (Wythe County: Harvill et al. 1986). The three occurrences in Washington County, Maryland are a large population on a bluff of calcareous shale along the Potomac River west of Hancock, and two small populations on limestone above the Potomac River west of Sharpsburg and north of Harpers Ferry (Boone pers. comm.). The population in Jefferson County, West Virginia, occurs on phyllite along the Shenandoah River about 14 kilometers south of Harpers Ferry. Phyllite commonly supports calciphilic species in this region (Bartgis pers. comm.).

The Franklin County population of *Hydrophyllum macrophyllum* in Pennsylvania occurs near the eastern edge of the Appalachian Mountain Section of the Valley and Ridge Province (Guilday 1985). The elevation is about 150 meters and the slope varies from 10 to 45 degrees with a southeastern aspect. The parent substrate is Middle or

Lower Devonian limestone and calcareous shale of the Onondaga and Old Port Formations, undivided (Berg and Dodge 1981; Geyer and Wilshusen 1982). The dominant soil type is the Hagerstown-Rock outcrop complex (Long 1975).

The community is a mixed deciduous "rich woods." Its floristic composition (listed in the Appendix) spans the associations of "dry-mesic calcareous central forest" and "mesic central forest" as they are defined in Pennsylvania (P.N.D.I. 1983). The overstory includes mesophytic indicators such as *Acer saccharum, Liriodendron,* and *Tilia;* but species of *Quercus* and *Carya* are also important. Ericaceae are absent except for a few plants of *Vaccinium pallidum,* which occur on shale just above the upper edge of the zone of *Hydrophyllum macrophyllum.* Percent cover of the understory approaches 100% on the lower part of the slope in spring; it decreases upslope and during the rest of the growing season.

The community is unusual for southcentral Pennsylvania. Some of the species that are scarce or absent in most of Pennsylvania are found throughout West Virginia (Strausbaugh and Core 1977), the Potomac River drainage of Maryland (Riefner and Hill 1984; Boone 1984b), and/or the Ohio River drainage of southwestern Pennsylvania and southeastern Ohio (Wherry et al. 1979; Keener and Park 1986; Cusick and Silberhorn 1977). These species include *Trillium sessile, Delphinium tricorne, Jeffersonia diphylla,* and *Aster shortii,* which are abundant at the site; plus *Carex jamesii, Ranunculus micranthus, Matelea obliqua, Phacelia purshii,* and *Ruellia strepens,* which are scarce or restricted there. All of the preceding species plus several others from the site are noted to be calciphilic in Maryland: *Carex hitchcockiana, Quercus muhlenbergii, Aristolochia serpentaria, Floerkea proserpinacoides, Chaerophyllum procumbens, Mertensia virginica,* and *Campanula americana* (Boone 1984b; Riefner and Hill 1984). The calciphilic distribution of *Hydrophyllum macrophyllum* in Maryland is described above, and this species occurs "especially over calcareous soils" in the Blue Ridge Province of Virginia and the southern Appalachians (Wofford 1989). The Franklin County population of *H. macrophyllum* and many of its calciphilic associates extend into the ruderal community at the base of the slope along the roadside but not into the floodplain forest on the other side of the road.

Several of the species are "Plants of Special Concern in Pennsylvania," although none are rare globally. These include *Corallorhiza wisteriana, Ranunculus micranthus, Matelea obliqua, Hydrophyllum macrophyllum,* and *Ruellia strepens* (P.N.D.I. Data Base). Some species at the site are rare or endangered in Maryland, namely *Carex hitchcockiana, Corallorhiza wisteriana, Matelea obliqua, Hydrophyllum macrophyllum,* and *Ruellia strepens.* The species classified as "uncommon" in Maryland include *Carex jamesii, Delphinium tricorne, Ranunculus micranthus, Phacelia purshii,* and *Aster shortii* (Boone 1984a). *Corallorhiza wisteriana* is the only species listed above that is endangered or threatened in West Virginia (W.V.W.H. Data Base).

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APPENDIX

The following species occur within the extent of the Franklin County population of *Hydrophyllum macrophyllum* and the associated calciphilic flora described above. The list is based on at least one visit per month in April 1986, 1987, and 1988; May 1987; June through October 1988; April through July 1989; and March 1990. Nomenclature follows Kartesz and Kartesz (1980). Asterisks (*) indicate county records. "R" indicates ruderal or floodplain species restricted to the base of the slope along the roadside. "PH" indicates voucher specimens (Jeffrey L. Walck) at the Academy of Natural Sciences Herbarium in Philadelphia. The other collection numbers signify voucher specimens (Larry H. Klotz and Jeffrey L. Walck) deposited at the Shippensburg University Herbarium. "Photo" indicates voucher by 35-mm color transparencies.

TREES: Aceraceae: *Acer rubrum, A. saccharum*. Cupressaceae: *Juniperus virginiana*. Fabaceae: *Robinia pseudoacacia*. Fagaceae: *Quercus alba, Q. muhlenbergii, Q. montana, Q. rubra, Q. stellata, Q. velutina*. Juglandaceae: *Carya cordiformis, C. ovata, C. tomentosa, Juglans nigra*. Magnoliaceae: *Liriodendron tulipifera, Magnolia acuminata*. Nyssaceae: *Nyssa sylvatica* var. *sylvatica*. Oleaceae: *Fraxinus americana*. Pinaceae: *Pinus strobus*. Platanaceae: *Platanus occidentalis*. Rosaceae: *Prunus avium, P. serotina*. Simaroubaceae: *Ailanthus altissima*. Tiliaceae: *Tilia americana*. Ulmaceae: *Celtis occidentalis, Ulmus americana, U. rubra*.

UNDERSTORY TREES, SHRUBS, AND WOODY VINES: Anacardiaceae: *Rhus aromatica, R. typhina, Toxicodendron radicans*. Berberidaceae: *Berberis thunbergii*. Betulaceae: *Carpinus caroliniana, Ostrya virginiana*. Caprifoliaceae: *Lonicera japonica, Sambucus canadensis, Viburnum acerifolium, V. prunifolium*. Celastraceae: *Euonymus atropurpureus*. Cornaceae: *Cornus alternifolia, C. florida*. Elaeagnaceae: **Elaeagnus umbellata* 1684. Fabaceae: *Cercis canadensis*. Lauraceae: *Lindera benzoin, Sassafras albidum*. Menispermaceae: *Menispermum canadense*. Moraceae: *Morus rubra*. Ranunculaceae: *Clematis virginiana*. Rosaceae: *Amelanchier arborea*, **Crataegus uniflora* 1808, *Rosa carolina*, **R. multiflora* 1685, *Rubus occidentalis, R.* section *Eubatus* sp. Smilacaceae: *Smilax hispida, S. rotundifolia*. Staphyleaceae: *Staphylea trifolia*. Vitaceae: *Parthenocissus quinquefolia, Vitis riparia*.

FERNS: Adiantaceae: *Pellaea atropurpurea*. Aspleniaceae: *Asplenium platyneuron, A. trichomanes* 1766, 1803, *Dryopteris intermedia, D. marginalis, Polystichum acrostichoides, Woodsia obtusa* 1794. Ophioglossaceae: *Botrychium dissectum, Botrychium virginianum*. Polypodiaceae: *Polypodium virginianum*.

GRAMINOIDS: Cyperaceae: *Carex amphibola* var. *turgida* 1614, *C. blanda* 1609, 1624, *C. communis* 1611, *C. digitalis* 1610, **C. hitchcockiana* 1619, 1623, **C. jamesii* 1612, *C. oligocarpa* 1607, *C. rosea* 1608, 1615, 1656, *C. sparganioides* 1621, 1634, 1649. Poaceae: R *Arrhenatherum elatius* var. *elatius* 1798, *Bromus pubescens* 1635, 1646, 1648, *B. sterilis* 1769, 1770, *Dactylis glomerata* 1768, *Dichanthelium boscii* 1620, 1719, **Elymus villosus* 1651, 1690, *Festuca elatior* 1636, 1797, *F. obtusa* 1616, *Hystrix patula* var. *patula* 1650, 1673, 1678, R *Lolium perenne* 1796, *Muhlenbergia sobolifera* 1675, 1720, *Poa compressa* 1618, *P. cuspidata* 1765, *P. pratensis* 1785, **P. trivialis* 1613, **Sphenopholis obtusata* 1605, 1606.

FORBS: Acanthaceae: *Ruellia strepens* 1679. Apiaceae: *Chaerophyllum procumbens* var. *procumbens* 1776, 1801, *Cryptotaenia canadensis*, R *Daucus carota, Heracleum lanatum*, **Osmorhiza claytonii* 1789, *O. longistylis* 1779, *Sanicula canadensis* 1680, *S. gregaria* 1795, *S. trifoliata* 1677, *Taenidia integerrima* 1791. Araliaceae: *Panax trifolius*. Aristolochiaceae: *Aristolochia serpentaria*, **Asarum canadense* var. *ambiguum* 1778. Asclepiadaceae: *Asclepias quadrifolia, Matelea obliqua* 0022 (PH), photo. Asteraceae: *Achillea millefolium, Ambrosia artemisiifolia* 1698, 1722, R *A. trifida* 1702, 1703, *Antennaria plantaginifolia* var. *plantaginifolia* 1780, R *Anthemis arvensis* 1799, *Aster cordifolius* var. *cordifolius* 1751, 1756, 1759, *A. lateriflorus* 1750, *A. patens* 1752, R *A. pilosus* var. *pilosus* 1760, *A. shortii* 1758, R *A. simplex* 1757, *Bidens bipinnata* 1810, *Cacalia atriplicifolia*, R *Centaurea maculosa*, R *Cichorium intybus, Cirsium altissimum* 1688, R *Conyza canadensis* 1696, *Erigeron annuus* 1687, *E. philadelphicus* 1788, *Eupatorium rugosum* 1755, *Helianthus decapetalus* 1669, 1823, *Heliopsis helianthoides* var. *helianthoides* 1652, 1706, *Hieracium venosum* 1793, *Krigia virginica* 1775, R *Lactuca biennis* 1709, *L. floridana* var. *floridana* 1670, *L. serriola* 1682, *Prenanthes* sp., *Senecio aureus, S. obovatus* 1792, *Solidago caesia* 1754, *S. canadensis* var. *hargeri* 1694, 1707, 1708, *S. canadensis* var. *scabra* 1761, *S. gigantea* var. *serotina* 1668, *S. rugosa* 1753, *Taraxacum officinale*, R *Verbesina alternifolia* 1699. Balsaminaceae: *Impatiens* sp.–*I. capensis* and *I. pallida* occur on the adjoining floodplain. Berberidaceae: *Jeffersonia diphylla* 1831, *Podophyllum peltatum*. Boraginaceae: *Buglossoides arvense* 1772, *Mertensia virginica* photo–mostly blue-flowered, some nearly white-flowered. Brassicaceae: *Alliaria petiolata, Arabis laevigata, Barbarea verna* 1790, *B. vulgaris, Cardamine hirsuta* 1781, *Dentaria laciniata, Erophila verna, Hesperis matronalis, Lepidium campestre* 1782, **Thlaspi perfoliatum* 1764. Campanulaceae: *Campanula americana, Lobelia inflata, Triodanis perfoliata* 1657.

Caryophyllaceae: *Arenaria serpyllifolia* 1774, *Cerastium nutans, Paronychia canadensis,* R *Silene alba, S. caroliniana* ssp. *pensylvanica, S. stellata, Stellaria media.* Commelinaceae: R *Commelina communis.* Convolvulaceae: *Ipomoea pandurata* 1671. Dioscoreaceae: *Dioscorea quaternata.* Fabaceae: *Amphicarpaea bracteata,* **Coronilla varia* 1686, *Desmodium nudiflorum, Lespedeza procumbens* 1809, R *Medicago lupulina,* R *Melilotus* sp., R *Trifolium pratense, Vicia caroliniana.* Geraniaceae: *Geranium columbinum, G. maculatum.* Hydrophyllaceae: **Hydrophyllum macrophyllum* 0008 (PH), 1838, *H. virginianum,* **Phacelia purshii* 1837. Iridaceae: *Sisyrinchium mucronatum* 1783. Lamiaceae: *Cunila origanoides, Glechoma hederacea, Hedeoma pulegioides, Lamium amplexicaule* 1763, **L. purpureum* 1762, *Monarda clinopodia* 1672, *Scutellaria elliptica* var. *elliptica.* Liliaceae: *Allium canadense, A. vineale, Ornithogalum umbellatum, Polygonatum biflorum, P. pubescens, Smilacina racemosa,* **Trillium sessile* 1829–mostly with maroon petals, rarely with yellowish green; *Uvularia perfoliata.* Limnanthaceae: *Floerkea proserpinacoides.* Onagraceae: *Circaea lutetiana,* R *Oenothera biennis.* Orchidaceae: *Corallorhiza wisteriana*–one plant observed. Oxalidaceae: *Oxalis stricta* 1689, *O. grandis* 1658. Papaveraceae: *Corydalis flavula, Dicentra cucullaria* photo–white-flowered and pale pink forms; *Sanguinaria canadensis.* Plantaginaceae: R *Plantago lanceolata,* *R *P. rugelii* 1683. Polemoniaceae: *Phlox divaricata* photo–mostly white-flowered, some pale blue; *Polemonium reptans.* Polygonaceae: *Polygonum caespitosum* var. *longisetum* 1674, 1681, 1693, R *P. convolvulus* var. *convolvulus* 1713, *P. persicaria* var. *persicaria* 1721, *P. virginianum,* R *Rumex* sp. 1802–possibly *R. patentia.* Portulacaceae: *Claytonia virginica.* Primulaceae: *Lysimachia nummularia.* Ranunculaceae: *Anemone virginiana, Aquilegia canadensis, Cimicifuga racemosa,* **Delphinium tricorne* 1830–mostly dark purple-flowered, some very pale purple; *Hepatica nobilis* var. *obtusa, Ranunculus abortivus, R. hispidus, R. micranthus, Thalictrum dioicum, T. thalictroides.* Rosaceae: **Agrimonia rostellata* 1676, *Geum canadense, Potentilla canadensis.* Rubiaceae: *Galium aparine, G. circaezans* var. *hypomalacum* 1653, 1654, *G. concinnum* 1655, *G. tinctorium* 1659, *Hedyotis nuttalliana* 1811. Saxifragaceae: *Saxifraga virginiensis.* Scrophulariaceae: **Penstemon canescens* 1839, *Scrophularia marilandica, Verbascum thapsus, Veronica arvensis.* Urticaceae: *Pilea pumila.* Verbenaceae: *Phryma leptostachya, Verbena urticifolia.* Violaceae: *Viola pedata* "var. *lineariloba* DC." (concolorous corollas) and "var. *pedata*" (bicolorous); *V. pubescens* var. *leiocarpa* 1771, 1777, *V. rafinesquii, V. sororia, V. striata, V. triloba.*

Addendum

On April 28, 1990 the junior author discovered *Hydrophyllum macrophyllum* in southwestern Pennsylvania (Ryerson Station State Park, Greene County). One population was found along a roadside and two other populations were found along hiking trails. At each site *H. macrophyllum* was the major understory component of the mixed deciduous woods. Together the populations number much greater than the Franklin County population described above. These three populations range from 0.6 to 1.6 kilometers from each other. The populations are in the Pittsburgh Section of the Appalachian Plateau Province (Guilday 1985). The parent substrate is the Greene, Washington, and Waynesburg Formations which consist of sandstone, siltstone, limestone, shale, claystone, and coal beds (Berg and Dodge 1981; Geyer and Wilshusen 1982). They are 200 kilometers from the population in Franklin County, Pennsylvania and 42 kilometers from the nearest population in West Virginia (Ohio County: Strausbaugh and Core 1977). The plants were in flower bud on April 28 and May 18, and a few were in flower on June 7 (S. Thompson pers. comm.). Voucher specimens (Walck 0430, Thompson 7210, Thompson 7214) were deposited at the Carnegie Museum of Natural History. Other searches at a nearby state gameland failed to yield *H. macrophyllum.*

A specimen (CM081821) at the Carnegie Museum of Natural History was recently reidentified as *Hydrophyllum macrophyllum* by the junior author. It was collected in Fayette County, Pennsylvania in 1957 and misidentified as *Hydrophyllum virginianum.*

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Strophostyles leiosperma in New Jersey: Adventive or Native?

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In Bartonia 55, I reported the rediscovery of *Galactia volubilis*[1] at a site near Cold Spring in southern Cape May County. That identification, which was based on fruiting specimens collected in November of 1988, was incorrect. With the collection of flowering material in August of 1989, I have determined that it is *Strophostyles leiosperma*,[2] a species not previously reported for New Jersey, and according to the manuals, not reported east of Ohio.

Subsequently, I discovered two additional locations for *S. leiosperma* in Burlington County during the 1989 field season. Several plants were observed on 17 September growing in dry sandy soil along a recently abandoned railroad at Woodmansie. The plants were in flower and fruit and grew with *Pinus rigida, Panicum virgatum, Sorghastrum nutans, Tridens flavus, Smilax glauca, Quercus ilicifolia, Q. marilandica, Prunus serotina, Rubus cuneifolius, Lyonia mariana, Chrysopsis mariana, Eupatorium album,* and *Solidago nemoralis*. The second site, found on 30 September, is about 0.5 mile west of Ewanville. Here it grows on a sandy roadside which parallels an abandoned railroad. Associated species include *Pinus virginiana, Strophostyles helvula, Tephrosia virginiana,* and some of the above listed species. Nearby is *Galactia regularis, Trichostema setaceum,* and *Verbena stricta*. The first location is about 70 miles NNE of the Cape May site, and the second is about 16 miles NW of the Woodmansie site.

Strophostyles leiosperma is not reported for New Jersey in the early catalogs and floras of Britton (1889), Stone (1911), and Taylor (1915), nor is it included in the more recent lists of Hough (1983) and Anderson (1989). No New Jersey specimens were found at CHRB, NY, or PH. Fernald (1950) reports its range as MS to TX, north to IN, WI, MN, NE, and CO, while Gleason & Cronquist (1963) extends its range eastward to AL and OH. In both these manuals the species is accepted as being native throughout it reported range.

Since the publication of these manuals the species range has been expanded into additional Northeastern states. Besides the New Jersey records cited, I have seen specimens from New York State (C. F. Austin, [without date or specific location,] NY) and Pennsylvania (Bucks Co.: PRR ballast just west of Pennsylvania Ave., Morrisville, 12 Oct 1958, B. Long 84411, PH) and it is reported for Accomack County, Virginia, by Harvill, et al. (1986).

The status for *S. leiosperma* in the Northeast is uncertain, since some authors regard it as native (Gleason & Cronquist 1963; Wiegman 1979) while others do not (Roberts &

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[1] Nomenclature follows Kartesz & Kartesz (1980), except for *Strophostyles helvula* (L.) Ell.

[2] *Strophostyles* differs from *Galactia* in its bearded styles. *Strophostyles leiosperma* differs from both *S. helvula* and *S. umbellata* by its tiny flowers (5–7 mm long vs. 8–14 mm long), hairy calyx-tubes, and seeds lacking a persistent scurfy coating (hence its common name "slick-seed bean").

Cooperrider 1982; Harvill et al. 1986; Wherry et al. 1979). Some of this uncertainty may be attributed to problems inherent in determining whether a species is truly native. Before examining the question of whether *S. leiosperma* is native or not in any of these states, let me first define what I mean by "native" or "non-native."

"Native" is here defined as a species which is part of the original flora, be it New Jersey, the Northeast, or North America. Its occurrence there is wholly due to natural means of dispersal, e.g., migration, natural catastrophes, animals, etc.

A bewildering number terms and categories have been used to describe "non-native" species. For example, "adventive," "alien," "escaped," "established," "foreign weeds," "fugitive," "introduced," "naturalized," and "waif" have been used by authors in describing New Jersey's non-native plant species. There is very little consistency in the usage of terms and categories, with each author defining them differently or inventing new ones. Britton (1889) and Stone (1911) make few or only slight distinctions between the various categories of non-native species, while Anderson (1989) creates four separate ones, and Hough (1983) uses a number of the terms listed above, but provides no definitions.

I prefer to divide the "non-native" species into two categories—adventive and introduced—each being defined by their geographic origins. An adventive species is native to North America but its occurrence in New Jersey (or elsewhere) is based on an accidental distribution that is attributable to the direct or indirect actions of man, e.g., spread via railroad and highway right-of-ways, escaped ornamental plantings, or through the creation of new habitats by the disturbance of natural communities. Introduced species include all species not native to North America for which at least their initial origin in a given area is traceable to man's activities. Collectively adventive and introduced species are referred to as non-native. "Naturalization" is the process by which non-native species are intergrated into the native flora. It is achieved through successful establishment and the colonization of habitats outside of cultivation by a propagule. Some species never spread much beyond their initial point of establishment, while others become widespread and are often conspicuous components of the flora.

On paper the distinctions between adventive, introduced, and native species can be made clear, but in a man-altered landscape the distinctions are sometimes obscured. Often, available data is inadequate to satisfactorily answer the questions raised: Was the species deliberately planted by someone or is it a disjunct? Were the seeds spread by birds or by the adjacent railroad ballast? Has the species always been a part of the native flora but its presence only recently documented? In the absence of conclusive data, the best that can be hoped for in such cases is the recognition of a reasonable fact pattern. This I believe can be done for *Strophostyles leiosperma*.

Since the species is native to North America, the introduced category is at once eliminated. The question is then, is it adventive or native?

The two Burlington County, New Jersey occurrences are adjacent to railroads and are, therefore, highly suspect. The Cape May record is not accounted for as conveniently. It grows along a sand road, which receives little use, and is reasonably isolated from major transportation corridors. How it got there remains a mystery. It seems doubtful to me that it was deliberately planted, since as far as I can ascertain, it has no ornamental appeal, or any agricultural, forage, or medicinal uses.

In Ohio and Pennsylvania the railroad provides an acceptable explanation, at least in part, to the species occurrence. Roberts and Cooperrider (1982) consider it "probably alien" in Ohio, noting two collections, one from railroad ballast and the other from a cultivated field. Allison Cusick (pers. comm.) cites one Ohio collection: Jackson Co.: Coalton, 3 Sep 1905, S. E. Horlacher s. n., OS. Since this specimen lacks specific habitat data, it is impossible to determine whether it represents a native occurrence. As noted earlier, the species has been collected from railroad ballast in eastern Pennsylvania. Charles Bier and Paul Wiegman (pers. comm.) report the following additional collections at CM from the western part of the state: Bedford Co., along railroad tracks, near Bedford Station, 9 Sep 1951, L. K. Henry s. n.; railroad bed, alt. 1070 feet, 1/8 mi E of Bedford Station, 20 Aug 1961—collected first in 1944, D. Berkheimer 20514. Wherry et al. (1979) indicate two additional records, one from Berks County, and one from Bedford County. The last may refer to Madley, a location cited in L. K. Henry's Flora of Bedford County (Charles Bier pers. comm.). The source of the Berks County record is unknown to me.

The New York State record is based solely on the previously cited C. F. Austin specimen. The specimen is undated but is certainly pre-1880 (the year of Austin's death). Given the inconsistencies of Austin's herbarium (Montgomery 1981; Snyder 1989), some may question the validity of this specimen.

The specifics of the Virginia record are not known to me, but Harvill et al. (1986) does include it under "Waifs and taxa of doubtful persistence." At a recent conference held at Virginia Polytechnic Institute, *S. leiosperma* was apparently excluded from listing as endangered or threatened in Virginia because of its uncertain native status (Chris Ludwig, Donna Ware pers. comm.).

That *Strophostyles leiosperma* grows along railroad right-of-ways does not preclude it from being native to any of the above cited Northeastern states. This may in fact be a typical habitat. Gleason (1952) describes the habitat for *Strophostyles helvula* as "Dry or sandy upland soil, often abundant on cinders." In the herbaria I visited I saw several collections of *S. leiosperma* from the heart of its range collected from along railroads or from other disturbed habitats. What makes the case for native status weak, I believe, is the apparent lack of occurrences in "unquestionably" native habitats and its seemingly recent appearance in most of the Northeast. One could argue, I suppose, that in addition to being extremely rare in the Northeast, *S. leiosperma*'s small, inconspicuous flowers may also account for the scarcity of eastern collections. I doubt that this is the case in southern New Jersey, with its long history of botanical exploration—especially the Cape May Peninsula and the Pine Barrens of Burlington County. At least two of the New Jersey sites have been previously botanized by Otway Brown, Bayard Long, Lou Hand, and Vincent Abraitys. I would be surprised if such adept field botanists had overlooked *S. leiosperma*.

Is *Strophostyles leiosperma* native in New Jersey or in any of the other northeastern states discussed? In my opinion, probably not. It is true that the origin of a few occurrences are still unaccounted for, and if viewed in isolation, they may seem puzzling, but if examined in context with other Northeastern occurrences, a reasonable explanation can be made. This explanation might simply be that adventive populations are now being spread through natural means of dispersal. The species is apparently established and on its way to becoming naturalized in the Northeast.

Perhaps through additional field work an "unquestionably native occurrence" might be discovered somewhere in the Northeast, or herbarium specimens not yet examined, may support a different conclusion.

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In the Norton-Brown Herbarium at the University of Maryland, we have long mounted specimens using as weights the lead slugs that made up the index to Joseph E. Harned's *Wild Flowers of the Alleghanies*. The index and engravings used in the book had been given to Dr. Russell G. Brown, a former curator of the herbarium, by the publisher, Sincell Printing Company of Oakland, Maryland. Harned's book was not owned by the herbarium or libraries of the College Park campus, although we had seen copies at the National Agricultural Library and at the Smithsonian Institution. Melvin L. Brown, an author with Russell Brown of the recent flora of Maryland (Brown & Brown 1972, 1980), had copies of both editions (Harned 1931, 1936b). However, both editions are sufficiently rare that, when Stafleu and Cowan (1979) published the second volume of their monumental *Taxonomic Literature*, the name of Harned was missing.

We were aware that members of the Harned family still lived in the Oakland area of western Maryland, but as is so often the case, we made only passing efforts to discover who they were. Two events were to spur us into action. First, a supplement to *Taxonomic Literature* is currently in the works, and we are determined that this Maryland pioneer floristician not be missed, and second, we fortuitously became acquainted with Dr. Harned's great-granddaughter, Judi Kahl, in an equestrian riding class in Landover, Maryland near Washington, D.C.

Joseph Edward Harned was born on 1 December 1870 in a log house built around 1800 at a farm named "Promised Land" along what is now Sander's Lane near Oakland, Garrett County, Maryland. Joseph was the only child of John Harned and his wife, Annie Davis Harned.

Promised Land originally was a tract of some 1200 acres surveyed for James Brooke in 1774. The tract was located just west of the Youghiogheny River northwest of Hutton, Maryland. Two trails, one from Oakland and the other from McCullough's Path, meet there, and previously the area had been an Indian village known as "Indian Meadow." Joseph B. Davis (1808–1890) married Sarah McMillen (1810–1905) and moved to Promised Land in 1861. Joseph and his son, John (1835–1916), had purchased 600 acres of the original farm from David Freeland. The elder Davis was a surveyor by trade, and he also raised cattle on the farm. The younger Davis, in 1906, wrote of his early years:

> Then this entire region was grazing ground for cattle, the native grass was abundant, flowers of almost endless variety and delicate hue attracted people.
>
> During the Summer season, herds of cattle could be seen in every direction, attracted by the facilities for grazing on the native grass, and being a dealer in cattle I was led to purchase land and secure a home on this mountain top. During the summer of 1859 I herded 600 head of cattle on what is known as the Herrington Creek Glade. At that time from 1000 to 2000 cattle were annually pastured within the radius of ten miles; deer were numerous, speckled trout could be caught in almost any of the streams. Farmers were few, and it was thought to be useless to try to raise wheat or corn.

Joseph and Sarah Davis had six children, including Annie (d. 1884). The Davis family was of Welsh descent and came to Pennsylvania in the early 1700s. Benjamin Davis, Joseph's father, was born there in 1770 and married Elizabeth Barker, four years his junior, the daughter of Captain Joseph Barker of Revolutionary War fame.

The Harned family came to America in the person of one Edward Harnet of Sandwich, Kent County, England, who arrived in the mid 1630s and settled at Salem, Massachusetts in about 1638. Edward Harnet IV was married twice, and one of his sons, Samuel Harned (1797–1878), lived near Ursina, Pennsylvania. He married Rachel King and had eight children, one of whom was John Harned.

John Harned (b. 1826) was born near Ursina and married Adeline Weismer of Somerset County. In 1867 he and his family moved to West Liberty, Iowa, where she died leaving him with four children. In 1870, John returned East, leaving the children in Iowa, and in that year he married Annie Davis in Harnedsville, Pennsylvania. It was then that John and Annie moved to Promised Land where Joseph was born in December. John Harned had purchased half-interest in the farm from John M. Davis and proceeded to manage the whole of it. In addition, for sixteen years, John Harned was Surveyor of Garrett County.

Annie Davis Harned died in 1884, after which John Harned married a Mrs. David Freeland, about whom we have no information. Following her death, John returned to Iowa where he died and was buried.

As an only child, Joseph Harned was apparently close to his mother who instilled in the boy a love of wild plants. Writing the dedication for his book in 1931, he acknowledged that even a half century later he owed to her "my great interest in Nature." His early years on Promised Land allowed him to wander freely through the floristically rich green glades of western Garrett County and to walk the three miles back and forth to attend the one-room Harrington Elementary grade school. When his mother died, Joseph, at age fourteen, was sent to Philadelphia to live with an uncle. There he attended high school and following his graduation, he spent a year teaching and serving as an apprentice in a drug store. It was in connection with his apprenticeship that Joseph entered the Philadelphia College of Pharmacy.

At the College, Joseph came in contact with John Michael Maisch (1831–1893). Maisch was German by birth and came to the United States in 1849, having been compelled, according to Harshberger (1899), to leave Germany because of "his connection with a party of revolutionists." In 1861, Maisch joined the College of Pharmacy of the City of New York becoming professor of pharmacy and materia medica. He subsequently returned to Philadelphia in 1863 where, after the war, he joined the Philadelphia College of Pharmacy, where he remained for twenty-six years. Maisch had a distinguished career as a teacher and researcher, educating many a young student in botany and encouraging them to enter the profession of pharmacy.

Upon receiving his degree in pharmacy, Joseph Harned returned to the mountains of western Maryland where, in 1891, he began to manage a drug store in Mountain Lake Park. In those years, this small town was a summer mecca for the elite of Washington and Baltimore. In the stifling summer months, all the hotels, boarding houses and cottages were filled to capacity with those escaping the heat of the coastal plain. The drug store, located near the Amphitheatre, was owned by Dr. J. Lee McComas of Oakland, and it was at the Oakland Pharmacy where all of the prescriptions were filled (Weeks 1949).

The Oakland Pharmacy was founded by Dr. J. Lee McComas in 1892 and was located in the Ravenscroft Building (Weeks 1949). In 1895, the Harneds moved to Oakland where Joseph purchased the Oakland Pharmacy from Dr. McComas. Unfortunately, in July of 1898, a major fire started in an Oakland saloon and within minutes several stores and offices were ablaze, including the Ravenscroft Building (Anonymous 1898). A clerk employed by Harned was awakened by the fire shortly after four in the morning and raised the alarm. According to *The Republican:*

> The Ravenscroft building was occupied by Mr. Joseph E. Harned as a drug store on the first floor and as a dwelling on the second floor. When the alarm was soundod [sic.] he and family were asleep and they had just time to escape from the building in the clothes they could grasp as they hurried from their rooms. Mr. Harned's little boy was carried out wrapped in a blanket with no clothing on except his night dress and was taken to a neighbor's house where he was found later by his mother who was almost crazed with the fear that he had been left in the burning building.

According to family tradition, all Harned was able to save were the pharmacy records, two mirrors and a son; interestingly, no mention was made of the Harneds' baby daughter. With the completion of the McComas Building shortly thereafter, the pharmacy was moved to this (and still present) site. In 1900, the family moved into a new home on Second Street where descendants of the Harned clan still reside.

Concomitant with his move to Garrett County was Joseph Harned's marriage, in 1894, to Emma Bauer (1870–1950)[1] of Cumberland, Maryland. Their marriage was to last more than fifty-seven years. Their only son, Harold Hetzel Harned (1895–1983), was born in Oakland with a daughter, Louise Harned Burdett (1897–1964), arriving two years later.

Life in Oakland was rewarding to Harned, and in the warmth and glow of a new family and a thriving business, he began to turn his attention to the local wild flowers of western Maryland. It is unclear exactly when he first began to compile notes on the local plants, but it was probably shortly after he moved to Oakland. In 1908, Harned wrote his first article on the plants of Garrett County, and was in communication with Ferdinand Schuyler Mathews (1845–1938) of Cambridge, Massachusetts, about preparing illustrations for a book he was planning.

Mathews was a skilled botanical artist who had already published his *Field Book of American Wild Flowers* in 1902 and was then working on a similar book on the trees and shrubs (Mathews 1915). A series of line drawings were executed in 1909 and 1910, with the water colors sent to Harned in August of 1912. According to Zook (1951), "a Harvard professor pointed out that the book would be far more valuable if it covered a larger area" than just western Maryland, so Harned put aside his original draft and set to work on treating the flora of the Allegheny Mountains. If Zook's account is correct, this would have been around 1915, but who the Harvard professor might have been is uncertain. Perhaps it was Benjamin L. Robinson who, in the introduction to Harned's book, is thanked for his "encouragement and practical suggestions." Perhaps, it was Mathews who, while not a member of the faculty at Harvard, was living in Cambridge and had a good business sense about how to market a book.

Harned was actively studying plants whenever he could find the time to be away from the pharmacy, but the full extent of this effort is not now known. Efforts to find dried specimens at the Smithsonian Institution, where his collections are supposedly housed, have largely been unsuccessful. O'Rourke (1950) mentioned that plants were sent to Harned by others, but it is unclear if these were herbarium specimens or just occasional samples for him to identify.

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[1] Emma Bauer, born 7 Jul 1870, was five months older than her husband, but just how much older became the subject of much local speculation. When she died on 28 July 1950, her husband would not allow the dates of her birth and death to be placed on the headstone so as not to satisfy the curiosity "of the old biddies" of Garrett County.

In 1910 he collected one of the paratypes of *Solidago harrisii* cited by Steele (1911); the plant was named for Edward Harris of Cumberland, who, along with Harned and Professor George M. Perdew, had studied the plant on the shales near the city. Prior to that, in September of 1909, Harned had collected a fruiting specimen of a *Eupatorium* that apparently Steele considered unusual and at one time intended to describe as *E. harnedii.* Although the type, now at the U.S. National Herbarium of the Smithsonian Institution in Washington, D.C., was originally identified as *E. purpureum* L., Harned himself annotated it "*E. harnedii*" and published the name in 1931. According to King and Robinson (1987), *E. harnedii* Steele ex Harned (Wild Fl. Alleghanies 501. 1931) is a synonym of *E. purpureum.*

The original hand-written manuscript (Harned 1915) is still extant and available for study at the Hunt Institute for Botanical Documentation, Carnegie-Mellon University, in Pittsburgh. This apparently was the version completed about the time Harned began to search for a publisher. The suggestion by Zook (1951) that the draft was finished at about this time appears to be correct based on an examination of the manuscript's contents. This is certainly the case for Harned's treatment of *Solidago harrisii.* In his pencil draft, he considered the Cumberland plant to be a variety of *S. arguta* Aiton, with Steele and Perdew its authors. He was aware of Steele's (1911) article and of Britton and Brown's (1913) reduction of the name to synonymy under *S. arguta.* Although Harned (1931) referred to the plant using Steele's binomial in his book, it is termed a "variety" in the discussion, and it is interesting to speculate when and how he came to consider the plant by the rank and authorship he used in the draft. Today, of course, the plant is known as *S. arguta* var. *harrisii* (Steele) Cronq. (Cronquist 1977, 1980).

In the original manuscript no mention is made to either *Eupatorium harnedii* or to the other new species described by Harned, *Clintonia alleghaniensis* (Wild Fl. Alleghanies 117. 1931).

Expanding the geographic range of his flora from western Maryland to the Allegheny Mountains required an additional fifteen years of study (Zook 1951). A comparison of the 1915 (Harned 1915) manuscript with an extant 1930 typescript version (Harned 1930) that became the basis of the published book reveals few changes. While there were a few species added in manuscript, few are found only outside Maryland.

An exact definition of the Alleghenies[2] is not given by Harned (1931) except that the Allegheny Mountains were "a part of the great Appalachian system. . . ." From the discussion in the book, he apparently intended his treatment to cover the wild flowers of the mountainous regions of Maryland and portions of adjacent Virginia, West Virginia and Pennsylvania in a radius of about a hundred miles from Oakland.

Harned adopted an appealingly descriptive, almost "flowery" style of writing. In part this was to satisfy a diverse audience, but it also appears to have been a reflection of the man himself. In his introductory remarks, he has a chapter entitled "Plants That

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[2] The preferred spelling for the mountain range, according to the Funk & Wagnalls 1913 dictionary, was "Alleghany," although today's usage favors "Allegheny."

Have Acquired Unusual Habits" and some of his headings are "Plants that Crawl," "Plants that have Learned to Sleep," "Armoured Plants," "Fishing Plants" and "Plants that Build Airships." Under the heading of "Plants that Provide Entertainment" one finds:

> All the world loves entertainment of one kind or another. It is a disposition supposedly peculiar to mankind. Yet man is not the only living exponent of this claim. For if you will allow your imagination a little freedom you will soon discover, even among the lowly flowers, wonderfully built palatial halls furnished with softly cushioned chairs, golden-lace draperies, satin finished pictures all exquisitely painted; powder and perfume already in waiting for the invited guests; the guests in every instance being required to perform a certain task, namely, that of pollen bearer.
>
> While insect guests are welcomed amid such gorgeous display, there is often a strange lack of receptive hospitality. Indeed this may be said of both flower and insect. Some flowers, orchids for example, practice deception and trickery. The Marsh Marigold [*Caltha palustris* L.], one of our earliest spring flowers, occasionally has an exceptional guest—a tiny musician: just a little green frog. His concert is rendered in the evening while he is seated on the leaf of this bog plant. Can you imagine the purpose of the singer or the nature of his audience?
>
> Whatever the form of entertainment provided by the plant and its flower may be, one thing is true, namely, that a selfish interest has prompted it, although there may come to both flower and insect mutual benefit.

Under the heading of "Plant Marriages and the Guests that Aid in the Ceremony," Harned began his subject with the following:

> Perhaps the most fascinating subject relating to the life-history of plants is the story of how they marry and are given in marriage. But the whole story is too lengthy to be recited in detail in the allotted space. . . .

After noting that "scarcely a marriage is performed without a bountiful display of floral decorations," he continued:

> Briefly stated, flowers are the husbands and wives of plants. They have their short period of courtship which usually culminates in matrimony. . . . The male individuals are the stamens, or fertilizing organs, and generally consist of two little pollen-bags called the anthers, and a slender stalk known as the filament.
>
> The female individuals are the pistils, one or more of which stand in the center of the flower, and thus terminate its axis of growth. They are surrounded by the stamens and are called the fertile or seed-bearing organs.
>
> The flower is not a simple passive victim in the insect's sweet pillage, but is invested with definite inborn aspirations or tendencies toward ideals and companionships.

Even his discussions of some species are filled with wondrous images and even a degree of patriotism. Under *Aquilegia canadensis*, he remarked:

> The early wild flowers of mountain regions seem to have selected the Columbines for their reception committee and to have stationed them on high, rocky balconies to extend a most hearty welcome to all passing strangers coming within nodding distance. At least they fulfill their social obligations in a most courteous and dignified manner, seemingly desirous in their efforts to make one feel at home, extending the right hand of good fellowship to all visitors alike. This is doubtless one reason why in a recent discussion among our scientific men they suggested the Columbine as most appropriate for our National flower, for as we know America has always welcomed the immigrants from every nation with the same impartial hospitality and good will.

As a member of The Wild Flower Preservation Society, Harned was very much involved in the seemingly endless discussion about what should be the national flower. In his book he mentioned several under discussion, but his own favorite was the rose. He devotes five printed pages to the virtues of the rose claiming that ever "since the advent of man the rose has maintained undisputed sovereignty in the floral kingdom. . . . It is unrivaled, both in popular and poetic fame, for rare indeed is the masterpiece of literature in poetry or prose that fails to draw from the well of its fragrant cup."

As a serious botanical work, the organization and structure of *Wild Flowers of the*

Alleghanies was, in many ways, innovative in its technical approach. To be sure the book was written primarily for a lay audience, but Harned introduced and then used precise terminology. Perhaps the most novel of his ideas was his illustrated key to the families:

> The author, recognizing the importance and advantage of a knowledge of the distinguishing characters of the different families of plants has, at considerable expense, and after many years of comparative research, found it possible to arrange an "Illustrated Key to the Families of Plants."

Each drawing was of a single representative of a plant family. Each showed the "leaf, flower, fruit and either an enlargement of the flower or the structural plan." In addition to the illustrations, each family was described in considerable detail. It was Harned's idea that a user of his work would learn to recognize families, after which he would be in a position to identify the individual species belonging to that family. In addition to instructions on how to collect, press and preserve plant specimens, Harned reviewed each plant part and introduced the appropriate descriptive nomenclature; many of the terms were augmented by drawings.

Harned included in his flora a two-page chapter by William Weber entitled "Improving Flowers by means of Cross-fertilization." Weber (1869–1935) was the third of eleven children born to Henry Weber Sr. and Catherine Schutz Weber, the elder of German birth. The Weber family came to Garrett County in 1883, built a home they called "Seelheim" in Oakland, expanded Henry's already established grocery business in Oakland and entered into horticulture, truck farming and the dairy business. According to Robinson (1963), "the first telephone in Garrett County was between the Oakland Hotel, the Oakland railroad station, Weber's and the Deer Park Hotel" indicating the importance of the family in the local economy. Henry became a leading national horticulturalist, winning first prizes at the Chicago World Fair in 1893. When he died in January of 1904 in his sixty-ninth year, the gardening and florist's business fell to William. The younger Weber was essentially the same age as Joseph Harned and shared his love of flowers, so a collaboration was easily established between the two men. Although Weber's remarks are rather quaint by present-day standards, he does briefly describe the processes and pitfalls of hybridization and the problems of developing commercially valuable cultivars so that the reader can appreciate the difficulties of the plant breeder.

Wild Flowers of the Alleghanies was published by Mr. Benjamin H. Sincell of the Sincell Printing Company of Oakland who also published *The Republican*. His son Donald took on the book as his personal project, including running the linotype machine and setting the type. In the 9 April 1931 issue of that newspaper, publication of the flora was announced. The anonymous author of the article, probably the younger Sincell, commented on the more technical aspects of the book:

> With the exception of the binding, and printing of the eight colored illustrations, the entire work of composition and publishing was executed by the Sincell Printing company, publishers of The Republican. The book is five and one-half by eight inches in size, and was printed on 70 lb. Cumberland Coated book paper. It is one and one-half inches thick, and the type is very legible, being somewhat larger than newspaper type.

The Oakland paper also reported that many "leading botanists of the age have aided in proof reading the text." Just as he started to read page proofs Harned suffered a hemorrhage of the eye which prevented him from completing the task (O'Rourke 1950). Among those who came to his aid were Edward S. Steele who had been associated with the Smithsonian Institution; Karl M. Wiegand of Cornell University who wrote the key to the families; Dr. Rebecca Thayer, professor of English at Wooster

College, Ohio; Naomi Harned who helped with grammar and spelling; Dr. Edward T. Wherry, then employed by the Department of Agriculture in Washington, D.C. According to Harned's introductory remarks, however, Wherry was the only one to have read all of the proofs (save the introduction itself). In the introduction Harned indicated that the color plates were produced by the J. Horace McFarland Co. of Harrisburg, Pennsylvania, and the line drawings were photographed and engraved by The Alpha Photo Engraving Co. of Baltimore, Maryland.

Although *The Republican* declared *Wild Flowers of the Alleghanies* to have been "published" on 9 April 1931, there is no indication that the book was actually available for distribution. Harned kept a detailed record of all copies of the book that he sold, and according to that document now in the possession of the Kahl family in Oakland, he "delivered" copies of the book to the Accident, Friendsville and Grantsville high schools on 27 April 1931. Other copies were quickly sent to Kempton, Oakland and Kitzmuller high schools, with a copy given to the Garrett County Free Library on 2 May. It would appear that 27 April must be regarded as the effective date of publication for nomenclatorial purposes (Art. 29.1; Greuter et al. 1988). According to Harned's sale records, there were three copies of the second edition left when an accounting was made on 15 Oct 1952.

The book was well received and reviewed in numerous local and regional newspapers and some scientific journals. Nearly all were kind and positive, with Cowles (1933) stating that Harned "is to be congratulated on the publication of a work that in content and typography may well be taken as model of its kind." In the same review, Cowles said: "Obviously the author is a field botanist and a nature lover of rare enthusiasm, whose spirit is sure to be imparted to those who read and use the volume." When he was about to release the second edition, which was published on 10 Jul 1936, Harned (1936a) prepared a fourteen page advertisement citing the many published comments made about the first edition as well as those he had received from his correspondents. Among those whose comments were included by Harned were C. L. Shear, Gifford Pinchot, Forest Shreve, Willard Clute, George T. Hastings and Frederick W. Coville. Various college-based botanists commented favorably upon the book, among them Charles C. Plitt of the University of Maryland, A. N. Ward of Western Maryland College, C. O. Rosendahl of the University of Minnesota, O. E. Jennings of the University of Pittsburgh and P. D. Strausbaugh of West Virginia University. Writing later about the second edition Strausbaugh (1937) commented:

> There is here a wealth of botanical science, but the author has enriched his accounts by the introduction of plant legends, folk lore, plant and insect relationships, historical references, and medicinal properties. . . . One of the most clever and original contributions of the book is the illustrated key to the families. This key alone, or used in connection with the analytical key following it, will make the identification of many of the plants of this region, easy and delightful even for the layman. . . . Here is a book that can be enthusiastically recommended to both the layman and the professional botanist. Although popular, it is likewise authentic. . . . One can not read these pages without catching something of the spirit of the enthusiastic nature lover who penned them.

On the back cover of the issue of *Castanea* in which the above review appeared was an advertisement for Harned's book. At the bottom was a note indicating that Harned would be willing to "deliver an illustrated lecture on the subject, 'A Walk in Nature's Garden,' before high school students, Garden Clubs, or Botany classes, at very moderate rates." Harned gave many lectures and had a wonderful collection of slides.

After his death, the slide collection passed to daughter Louise, who used them to illustrate her own talks to garden clubs around Mt. Airy, Maryland.

The press run for the first volume was a thousand copies, and these were exhausted within five years; a thousand copies of the second edition were also published.

For the second edition, Harned increased the number of colored plates from eight to sixteen, changed the color of the book cover from blue to green, and added a five page supplement (pp. 617–621) wherein he reported the discovery of *Menyanthes trifoliata, Cypripedium reginae* and *Sarracenia purpurea*. The latter was of particular significance to Harned.

For over thirty years Harned had attempted without success to find a pitcher plant in his floristic area. In 1933, "a small boy presented for my examination an herbarium of native plants in prize competition. In this collection, to my great surprise, was the long-sought pitcherplant."

The exact location of the discovery was not revealed for "the sake of wildflower preservation," but his actions were all for naught. The Pennsylvania swamp where the plant was found has since been destroyed and the area converted into a reservoir. Nonetheless, it is clear that Harned studied the plant right up to the last moment before going to press. He reported that he dug up a plant on 25 April 1936 and studied it for thirty-two days (to ca 27 May). Melvin Brown recalled (pers. comm.) that as a youngster he remembers seeing a living specimen of *Sarracenia purpurea* in the Oakland Pharmacy; pressed specimens of the plant are still in the possession of the Kahl family in Oakland.

According to Helen Harned Kahl, there was always a fresh wildflower on the soda fountain at the drugstore, and it was often a pitcher plant. But it was the Venus' flytrap that most fascinated the local youngsters who loved to touch the hairs on the leaf and trip the trap.

The publication of *Wild Flowers of the Alleghanies* brought considerable fame to both Harned and Oakland. While none of Harned's correspondence has been found, it is clear that he received written praise from numerous citizens, and was acquainted with such luminaries as Thomas Edison, Harvey Firestone, Henry Ford and John Burroughs who camped near Swallow Falls in 1915 (Henry 1950). Apparently Harned took "a snapshot" of Edison and by means of a double exposure of Muddy Creek Falls near Oakland positioned the great inventor so that it made it appear that Edison was sitting on top of the water (O'Rourke 1950). Edison was interested in possible alternative sources of rubber and discussed the matter with Harned. Later, Harned visited Edison at his home in New Jersey. Robinson (1949) reported that on 27 September 1946 Albert Einstein came to Oakland and spent "several days" at Deep Creek Lake. Harned spent an afternoon with Einstein and presented him with a copy of his book. The Princeton professor so enjoyed the book, the story goes, "that he read it all in one night" (Henry 1950). Another friend was Dale Carnegie who praised Harned in a letter that was later read at Harned's funeral (Core 1951; Boone 1965).

Harned received an honorary doctoral degree from West Virginia Wesleyan in 1948 and in the spring of 1949 a similar honor was granted by Western Maryland College.

As Harned neared and then passed into his eightieth year, two feature articles appeared in print. The *Baltimore Sun* article (O'Rourke 1950) described Harned as "venerable" and "distinguished by his white hair and moustache, his Piccadilly collar and diamond stickpin" as well as his friendly "chuckles and his blue eyes." Zook (1951), writing in *Nature Magazine* described him as a "mild-mannered, bespectacled gentleman with silvery hair and a piccadilly collar'' who ''from early spring until the snow'' kept ''a bowl of fresh wild flowers on the counter of his pharmacy.'' Helen Kahl remembers her grandfather as both a ''gentleman and a gentle man.'' He was always impeccably attired whether at the store or in the field, and constantly wore his diamond stickpin and his diamond ring.

Zook (1951) indicated that in addition to discovering new species of *Solidago, Clintonia* and *Eupatorium* as already discussed, Harned also had a ''fourth and most beautiful'' discovery, a ''white double trillium, which was found in the woods along the Cheat River in West Virginia.'' No specimens of this plant have been found, and Harned did not mention this expression in his book.

Zook (1951) noted that Harned was a deeply religious man, and judging by his church and community duties (Anonymous 1951a,b; Core 1951), he took his religious and civic responsibilities seriously. He was elected to a fellowship in the American Association of Science and Maryland Academy of Science, and he was a member of the Botanical Society of America and the Southern Appalachian Botanical Club.

The later years brought other honors to Harned as well. During Oakland's Centennial in 1949 ''he was selected as the man of the older generation to pass the torch, with all the noble traditions of the county, down to the younger generation'' (Anonymous 1951b) and in 1948 H. P. Sturm of Clarksburg, West Virginia, produced a seven-reel, 1600-foot colored, sound film entitled ''Wild Flowers of the Alleghanies'' which was dedicated to Harned (Core 1951). In September of 1950, the Harneds celebrated their fifty-seventh wedding anniversary celebration which was well attended.

After a long and productive life, death came suddenly to Joseph Harned. In mid April of 1951, shortly after the *Nature Magazine* article featuring him appeared in print, he suffered a heart attack at home. After a brief stay in the hospital he was able to return home only to be stricken again. He was hospitalized on Thursday, 3 May, but his heart failed repeatedly and he died quietly on Saturday afternoon, 5 May. Knowing that he would have preferred it, Harned's daughter Louise and granddaughter Helen gathered wildflowers for his casket, including the white trilliums especially beloved by him.

Life was full and happy for Joseph Edward Harned and his family. That he has been largely forgotten and ignored by the scientific community is not difficult to explain. He was a skilled and knowledgeable amateur and while his book was well known to a myriad of undergraduate students at small colleges from western Maryland to eastern Ohio, after his death his work was largely forgotten by professional taxonomists due mainly to the publication of Fernald's (1950) edition of *Gray's Manual* which, by virtue of its scope and the reputation of its author, eclipsed other fine floristic works of lesser geographic coverage in the eastern United States.

The two editions of Harned's book soon became rarities. By 1951 only a few copies remained to be sold or given away by members of Harned's family. The publisher, Sincell Printing Co. asked for and received permission to buy the nearly three tons of linotype lead slugs used to print the book that Harned had stored at the press. A brief effort was made to republish the book, but that went nowhere. In the mid 1950s Russell G. Brown, a professor of botany at the University of Maryland, was asked by Sincell to see if the University could use the engraved plates and Brown saved two boxes of copper plates. He was given the slugs containing the index, and these small pieces of lead have been used ever since at the Norton-Brown Herbarium (MARY) to weight down pressed plant specimens to their herbarium papers while the glue dries.

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We wish to thank the family of Joseph E. Harned for the many kindnesses extended to us during this study. Thomas and Helen Kahl of Oakland, Maryland, have been particularly generous, providing us with access to a copy of the original manuscript and their family photograph albums and scrapbooks. The Kahls have kindly presented the original 1915 handwritten copy of Harned's book to the Hunt Institution for Botanical Documentation. They also donated the original Mathews line drawings to Hunt. Some of the original water colors published in the book, as well as several never published, remain in the possession of the Kahl family. David Kahl, son of Thomas and Helen, discovered the date of birth of Emma Bauer and provided us with the information. Russell G. Brown and Melvin L. Brown have aided us with various aspects of Harned's professional career and those of others in western Maryland who were his associates. Melvin Brown has kindly told us his childhood memories of "Dr. Harned," as he was affectionately called, his drug store and his love of the Maryland flora.

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Noteworthy Records of *Carex* (Cyperaceae) from the Southeastern United States

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Sedges (*Carex,* Cyperaceae) are an important element of the flora of the southeastern United States, where Mackenzie (1933) lists 130 species from seven states. They occur in habitats as diverse as marshes, mesic forests, and dry, open sandhills. Despite the importance of sedges, many parts of the Southeast remain unexplored or poorly explored for *Carex*. This paper reports several recent collections that are noteworthy as rediscoveries of populations known from historic collections, new county records, and new state records.

Included in this report are notes on the habitats and distributions of twenty-two native species of *Carex* from Delaware south and west to Texas. Information on their ecology is from our field observations. Literature reviews, herbarium searches, and our field work provided distribution data.

The terminology of physiographic provinces and their sections follows Fenneman (1938), Pirkle & Yoho (1977), Riskind & Diamond (1988), and Morris (1989). Herbarium abbreviations follow Holmgren, Keuken, and Schofield (1981), except for ctb and srh (Charles T. Bryson and Steven R. Hill personal herbaria, respectively).

1. **Carex abscondita** Mackenz.

ARKANSAS. Howard Co.: ca. 8 mi W of Umpire, 17 May 1988, *Naczi 1924* (ctb, MICH). Montgomery Co.: 1.2 mi E of Pine Ridge, 11 May 1989, *Naczi 2142* (MICH, UARK). Phillips Co.: 1.5 mi N of West Helena, 15 May 1987, *Naczi 1598* (ctb, MICH, UARK). Scott Co.: ca. 2 mi N of Y City, 10 May 1989, *Naczi 2131* (MICH, UARK). Sevier Co.: 8 mi E of DeQueen, 10 May 1989, *Naczi 2126* (ctb, MICH, UARK). TEXAS. Jasper Co.: ca. 14 mi W of Kirbyville, 3 May 1988, *Naczi 1830* (ctb, MICH). Marion Co.: ca. 3 mi S of Jefferson, 12 May 1988, *Naczi 1871* (ctb, MICH). Smith Co.: ca. 15 mi N of Tyler, 7 May 1987, *Naczi 1539* (ctb, MICH, PH, TEX).

Carex abscondita inhabits moist deciduous forests, usually on the upper portions of floodplains and immediately adjacent slopes. It frequently grows with *C. amphibola* Steud., *C. blanda* Dewey, *C. digitalis* Willd., *C. jamesii* Schwein., *C. oxylepis* Torr. & Hook., and *C. willdenowii* Willd. Our collections indicate that *C. abscondita* is more widespread and common in the Delta region (Phillips County collection), Ouachita Mountains (Howard, Montgomery, and Scott counties), and West Gulf Coastal Plain (Jasper, Marion, Sevier, and Smith counties) than previously documented. *Carex abscondita* had been recorded from only a single county in easternmost Arkansas (Bryson 1980) and is known from a single county in the nearby Delta region of Mississippi (Carter, Morris, & Bryson 1990). In addition, it appears to be previously unrecorded for Texas (Mackenzie 1935; Correll & Johnston 1970; Bryson 1980).

2. **Carex austro-caroliniana** Bailey

NORTH CAROLINA. McDowell Co.: N of Pleasant Garden, 28 May 1987, *Naczi 1662* (ctb, DOV, MICH, NCU, PH, TEX).

Carex austro-caroliniana is a distinctive sedge of mesic deciduous forests. Though often common where found, it is a local species with a narrow range (southwestern North Carolina, western South Carolina, northern Georgia, northeastern Alabama, and eastern Tennessee (Bryson 1980). The specimens cited here are from a large population just above the floodplain of a stream. The site is just west of the eastern border of the Blue Ridge Physiographic Province. Apparently, this is the northeasternmost site for the species and a new county record (Radford, Ahles, & Bell 1968; Bryson 1980).

3. **Carex buxbaumii** Wahl.

DELAWARE. New Castle Co.: SW of McKays Corners, 22 Jul 1985, *Naczi 866* (DOV), 7 Jun 1988, *Naczi 2007* (ctb, DOV, MICH).

At this Coastal Plain site, *C. buxbaumii* was frequent within a small area of a wooded complex of shallow, often flooded depressions (DelMarVa Bays). It grew with *C. bullata* Willd., *C. stricta* Lam., and *Iris prismatica* Pursh in a shady, wet, peaty swale surrounded by *Acer rubrum* L.–*Liquidambar styraciflua* L. woods. Previously, the wide-ranging *C. buxbaumii* was collected but once in Delaware, farther north in New Castle County in 1868 (Tatnall 1946).

4. **Carex crebriflora** Wieg.

ARKANSAS. Drew Co.: 3.3 mi NW of Selma, 12 May 1988, *Naczi 1872* (ctb, MICH). Ouachita Co.: Camden, 11 Apr 1937, *Demaree 14415* (MICH). Sevier Co.: 8 mi E of DeQueen, 10 May 1989, *Naczi 2124* (MICH). OKLAHOMA. McCurtain Co.: ca. 7 mi NE of Broken Bow, 16 May 1988, *Naczi 1906* (MICH).

Carex crebriflora inhabits forested floodplains and mostly grows on moist to wet clays and clayey silts. Our specimens grew with *C. abscondita*, *C. blanda*, *C. flaccosperma* Dewey, and *C. intumescens* Rudge. *Carex crebriflora* was frequent at the Drew County site, but rare at both the Sevier and McCurtain County localities. The bulk of its geographic range is on the Coastal Plain (Bryson 1980) and the three Arkansas collections fit this pattern. However, the Oklahoma specimen is from the Ouachita Mountains. *Carex crebriflora* is previously unrecorded for Arkansas (Mackenzie 1935; Smith 1988) and Oklahoma (Mackenzie 1935; Taylor & Taylor 1989).

5. **Carex edwardsiana** Bridges & Orzell

TEXAS. Bandera Co.: ca. 4.2 mi NE of Lake Hills, 6 May 1988, *Naczi 1845* (MICH); ca. 4 mi N of Vanderpool, 7 May 1988, *Naczi 1846* (MICH). Bell Co.: near Sparta, 18 Apr 1931, *Wolff 2865* (TAES, US). Bexar Co.: ca. 3 mi W of Leon Springs, 5 May 1988, *Naczi 1839* (MICH). Comal Co.: E of Sattler, 10 May 1987, *Naczi 1565* (MICH). Hays Co.: 13.5 mi NW of Wimberley, 10 May 1987, *Naczi 1561* (MICH). Kendall Co.: Edge Falls, 3 May 1947, *Tharp, Webster, & Barkley 17T180* (NCU, TENN, TEX); 1.5 mi W of Kendalia, 9 May 1987, *Naczi 1552* (MICH); Sisterdale, 9 May 1987, *Naczi 1553* (MICH). Medina Co.: 1.9 mi W of rte 16–rd P37 jct, 6 May 1988, *Naczi 1842* (MICH). Real Co.: ca. 10 mi E of Leakey, 7 May 1988, *Naczi 1847* (MICH). Travis Co.: Austin, 18 Apr 1915, *Young s.n.* (GH, TEX); Mr. Beard's Place, Bull Cr., 18 Apr 1915, *Young s.n.* (TEX); N side of Lime Creek Rd at E edge of Sandy Creek LCRA Park, ca. 4.0 roadmiles N of FM 2769, 25 Apr 1982, *Carr 3838* (TAMU).

Carex edwardsiana is a local sedge, probably because its habitat is uncommon. Most populations inhabit sheltered, dry-mesic canyons and ravines where they grow in clayey soils on very rocky banks and slopes. At these sites, *C. edwardsiana* may be common and usually occurs just above streams or dry stream beds in light shade under *Carya illinoensis* (Wang.) K. Koch, *Celtis reticulata* Torr., *Juniperus ashei* Buchh., and *Quercus* spp. *Carex edwardsiana* often grows near the much more common *C. planostachys* Kunze, but inhabits slightly moister sites. Two collections (*Naczi 1553, 1839*) are from the upper portions of floodplains of creeks, where less than five plants per population grew in silty, rockless soil. Despite much exploration, we have never observed *C. edwardsiana* on the floodplains of large rivers, such as the Guadalupe, Medina, and Pedernales.

Carex edwardsiana is a narrow endemic of central Texas. All but one of the records cited are from the Balcones Canyonlands section of the Edwards Plateau. The exception is the Bell County collection, which is from the Balcones Escarpment in the Lampasas Cut Plain section of the Edwards Plateau. The collections cited above add five historic and six new county records to the recent collections from three counties (Kendall, Medina, Travis) mentioned by Bridges & Orzell (1989b). The known geographic range of *C. edwardsiana* is a narrow belt from Bell County southwest to Real County only 25 km wide and 300 km long.

6. **Carex gracilescens** Steud.

MISSISSIPPI. Lowndes Co.: 0.5 mi W of US hwy 45 Alt.–old US hwy 82 intersec., 15 May 1989, *Bryson 8552 & Naczi* (ctb, MICH); 2 mi S of Artesia, 15 May 1989, *Bryson 8558 & Naczi* (ctb, MICH).

We found small populations of *C. gracilescens* at previously unreported sites with *C. blanda* and *C. jamesii* in moist, clayey soils of woodlands in the Black Prairie region. These populations grew along streams under *Carya* spp., *Celtis* sp., *Fraxinus* sp., *Quercus* spp., and scattered *Juniperus virginiana* L. Known only from Lowndes, Monroe, and Oktibbeha counties (Bryson unpubl.), *Carex gracilescens* is uncommon in Mississippi.

7. **Carex gracillima** Schwein.

ALABAMA. Lawrence Co.: Bankhead National Forest, Bee Branch Scenic Area, 10 May 1979, *Bryson 2555* (ctb).

At this site in the Appalachian Plateaus Physiographic Province, *C. gracillima* grew in a deep ravine under mixed hardwoods, few pines, and *Tsuga canadensis* (L.) Carr. Mackenzie (1935) does not include Alabama within the range of *C. gracillima* and our collection appears to be a new state record extending the range of the species southward. The ravines along the Sipsey Fork of the Black Warrior River in Lawrence and Winston counties, Alabama also harbor the southernmost populations known for *C. careyana* Dewey, *C. hitchcockiana* Dewey (Bryson unpubl.), and *C. pedunculata* Willd. (Kral 1981).

8. **Carex granularis** Willd.

TEXAS. Red River Co.: ca. 4 mi SE of Johntown, 11 May 1988, *Naczi 1866* (MICH, TEX, WIS).

At this West Gulf Coastal Plain site, *C. granularis* was infrequent in heavy clay alluvium of a floodplain wooded with *Celtis* sp., *Fraxinus* sp., and *Ulmus* sp. Closely associated carices were *C. hyalina* Boott and *C. socialis* Mohlenbr. & Schweg. Correll & Johnston (1970) report *C. granularis* from only one Texas county, Bowie, which borders Red River County.

9. **Carex hyalina** Boott

ARKANSAS. Jackson Co.: W of Jacksonport, hwy 69 at the Black River, 27 Apr 1989, *Jones 2531 & Jones* (MICH, TAES); Jacksonport, near the White River, 14 May 1989, *Naczi 2171* (ctb, MICH, UARK). Little River Co.: 2.7 mi SW of Foreman, 16 May 1988, *Naczi 1913* (MICH). OKLAHOMA. McCurtain Co.: 3.6 mi S of Idabel, 14 May 1988, *Naczi 1882* (ctb, MICH). TEXAS. Bowie Co.: ca. 10 mi W of Bassett, 11 May 1987, *Naczi 1567* (MICH). Denton Co.: ca. 5 mi E of Denton, 10 May 1988, *Naczi 1859* (MICH, TEX). Liberty Co.: 0.8 mi W on hwy 105 from its jct with Trinity River, 8 May 1989, *Jones 2729 & Wipff* (ASTC, MICH, SMU, TAES). Morris Co.: ca. 9 mi N of Omaha, 5 Jun 1989, *Reznicek 8489 & Naczi* (MICH, TAES, TRTE). Red River Co.: ca. 4 mi SE of Johntown, 11 May 1988, *Naczi 1864* (MICH, TEX).

Carex hyalina is locally abundant on floodplains forested with hardwoods, where it grows in heavy clay alluvium. Every site of *C. hyalina* we observed also had *C. corrugata* Fern. Additional sedges frequently associated with *C. hyalina* were *C. blanda, C. bulbostylis* Mackenz., *C. cherokeensis* Schwein., *C. crus-corvi* Kunze, and *C. socialis.*

As Orzell & Bridges (1987) note, *C. hyalina* is known from very few collections from Arkansas, Oklahoma, and Texas. These authors cite specimens from one or two counties of Arkansas and refer to one collection from McCurtain County, Oklahoma. In Texas, Correll & Johnston (1970) list four counties for the species. Our collections add several counties to the known distribution of *C. hyalina*. The records are from the West Gulf Coastal Plain, except the Jackson County specimens. The Jackson County populations of *C. hyalina* grow in the Delta region and are disjunct approximately 325 km from the nearest populations in southwestern Arkansas.

10. **Carex impressinervia** Bryson, Kral, & Manhart

ALABAMA. Chilton Co., 17 Apr 1934, *Harper 3174* (MO), 27 Apr 1988, *Naczi 1796* (MICH), 31 May 1988, *Bryson 7870* (ctb), 3 May 1989, *Bryson 8510* (ctb, IBE, MICH, NLU, VDB). MISSISSIPPI. Marion Co., 4 May 1978, *Rogers 45167, Majure, & Herring* (TENN).

Carex impressinervia is found in a wide range of habitats (Bryson, Kral, & Manhart 1987) but mostly grows in rich, sandy loam of mesic deciduous forests on the upper edges of floodplains and adjacent slopes. The populations we have observed are large (100–1000 plants per population), but limited to very small areas. *Carex impressinervia* appears to be extremely rare. The collections we cite add two counties to the three previously known (Bryson, Kral, & Manhart 1987). We have observed populations of it in three of these counties (Bibb and Chilton counties, Alabama, and Montgomery County, North Carolina). Despite much search, we have failed to rediscover it in Forrest and Marion counties, Mississippi.

11. **Carex jamesii** Schwein.

MISSISSIPPI. Lowndes Co.: 2 mi S of Artesia, 15 May 1989, *Bryson 8557 & Naczi* (ctb, IBE). Oktibbeha Co.: 2.5 mi E of MS State Univ., 16 May 1989, *Bryson 8586 & Naczi* (ctb, IBE, MICH).

At these sites, *C. jamesii* was infrequent in moist, clayey soil along forested, small streams in the Black Prairie region. *Carex jamesii* grew with *C. gracilescens* near, but slightly higher upslope than, *C. willdenowii*. *Carex jamesii* is previously known in Mississippi only from the northeasternmost (Tishomingo) and northwesternmost (DeSoto) counties (Bryson unpubl.).

12. **Carex laxiculmis** Schwein.

ARKANSAS. Franklin Co.: ca. 3 mi E of Cass, 13 May 1989, *Naczi 2153* (ctb, MICH, UARK). Polk Co.: Rich Mt., 12.5 mi NW of Mena, 30 Aug 1979, *J. Taylor 28116* (DUR); 0.7 mi W of town of Rich Mountain, 11 May 1989, *Naczi 2138* (ctb, MICH, UARK). OKLAHOMA. LeFlore Co.: Rich Mt., ca. 150 yd W of the OK-AR state line, 30 Aug 1979, *J. Taylor 28127* (DUR).

Carex laxiculmis grows in a variety of soils, mostly in moist deciduous forests. It usually grows near streams, often at the upper margins of floodplains. Numerous plants occurred with *C. digitalis* at the Franklin County site and they were more scattered with *C. laxiflora* Lam. at the site of *Naczi 2138*.

Previously, *C. laxiculmis* was reported from but two counties in Arkansas (Smith 1988) and the Franklin and Polk county specimens are new county records. *Carex laxiculmis* is apparently new for Oklahoma (Taylor & Taylor 1989; C. Taylor pers. comm.). The collections we cite are from the Boston (Franklin County) and Ouachita Mountains (LeFlore and Polk counties) and are the westernmost of the species (Bryson 1980).

13. **Carex meadii** Dewey

MISSISSIPPI. Clay Co.: 4 mi S of West Point, 16 May 1984, *Bryson 3645* (ctb, MICH). Jasper Co.: 2.5 mi N of Missionary, 29 Apr 1987, *Bryson 5499* (ctb, MICH). Lee Co.: Bluff above Chiwappa Creek, E of Natchez Trace Parkway, 27 Apr 1985, *Bryson 3785* (ctb, IBE, MICH); 4 mi W of Verona, 27 Apr 1985, *Bryson 3788* (ctb, MICH). Lowndes Co.: 0.5 mi W of Mayhew, 16 May 1984, *Bryson 3642* (ctb, MICH); 4.2 mi S of Artesia, 25 May 1988, *Bryson 7803 & Morris* (ctb); 2 mi S of Artesia, 15 May 1989, *Bryson 8561 & Naczi* (ctb), *Naczi 2179 & Bryson* (MICH). Newton Co.: 2 mi E of Lake, 21 Jun 1986, *Bryson 4416* (ctb), 29 Apr 1987, *Bryson 5489* (ctb, IBE, MICH). Noxubee Co.: 0.5 mi N of Macon, 4 Apr 1985, *Bryson 3737* (ctb, MICH). Pontotoc Co.: Bluff overlooking Chiwappa Creek, E of Natchez Trace Parkway, 27 Apr 1985, *Bryson 3783* (ctb, MICH).

Our collections are from open areas with widely scattered *Juniperus virginiana* and *Quercus* spp. in the Black and Jackson Prairie regions. At these localities, *C. meadii* is restricted to a narrow band of heavy clay mixed with chalk fragments or chalky soils above chalk outcrops. Usually these narrow bands are at or near the crests of hilltops overlooking bottomlands. *Carex meadii* often occurs with *C. microdonta* Torr. & Hook., but its specialized habitat is usually more limited in size than that of *C. microdonta*. By virtue of its restricted habitat, *C. meadii* is uncommon in Mississippi. Recently discovered in Mississippi in Oktibbeha County (Bryson 1984), the above-cited specimens are new records for seven counties.

14. **Carex microdonta** Torr. & Hook.

MISSISSIPPI. Jasper Co.: 2.5 mi N of Missionary, 29 Apr 1987, *Bryson 5500* (ctb, IBE, MICH, NLU, SMU, TENN, VDB, VSC). Lowndes Co.: 3.8 mi S of Artesia, 26 Apr 1988, *Bryson 7795 & Morris* (ctb, IBE, NLU, VDB, VSC); 2 mi S of Artesia, 15 May 1989, *Bryson 8559 & Naczi* (ctb), *Naczi 2177 & Bryson* (MICH). Noxubee Co.: 2.5 mi NE of Macon, 15 May 1989, *Bryson 8577 & Naczi* (ctb).

In Mississippi, *C. microdonta* occurs in remnant prairies of the Black and Jackson Prairie regions. It grows in seasonally moist, heavy clay soils with small chalk fragments in open areas with widely scattered *Juniperus virginiana* and *Quercus* spp. Often, *C. microdonta* occurs with *C. meadii*.

Mackenzie (1935) includes Mississippi within the geographic range of *C. microdonta*, but we have been unable to discover the basis of his report. The first specimens of *C. microdonta* from Mississippi of which we are aware were collected in Newton County in 1965 by Robert Kral and Lowndes County in 1983 by Sidney McDaniel (Kral pers. comm.; McDaniel pers. comm.). Our Lowndes County collections are new stations for *C. microdonta*. The Jasper and Noxubee County specimens are new records that increase the number of counties from which *C. microdonta* is known in Mississippi to four.

15. **Carex ouachitana** Kral, Manhart & Bryson

ARKANSAS. Garland Co.: about 20 mi N of Hot Springs, Iron Springs Recreation Area, 15 Apr 1954, *Iltis 4741, VanSchaack, & Rudolph* (UARK), 24 May 1987, *Bryson 5750* (ctb, DUR, IBE, MICH, UARK, VDB).

Madison Co.: 2.1 mi S of Brashears, 13 May 1989, *Naczi 2156* (MICH). Perry Co.: N of Perry-Garland Co. line, E of AR Hwy 7 crossing of Ouachita Trail, 24 May 1987, *Bryson 5765* (ctb, IBE, MICH, UARK, VDB). Washington Co.: ca. 15 mi WSW of Winslow, 29 May 1988, *Naczi 1992* (MICH). OKLAHOMA. Cherokee Co.: 7.5 mi NNE of Tahlequah, 16 Apr 1977, *Lipscomb 1982* (NCU, SMU), 13 May 1987, *Naczi 1587* (MICH).

This recently described narrow endemic of Arkansas and Oklahoma (Kral, Manhart, & Bryson 1987; Smith 1988) mostly grows on dry-mesic, rocky slopes forested with *Acer saccharum* Marsh., *Carya* spp., and *Quercus* spp. Often, *Pinus echinata* Mill. and *Cornus florida* L. are scattered through these sites. Herbs frequently associated with *Carex ouachitana* include *C. amphibola, C. jamesii, C. oligocarpa* Willd., and *Monarda russelliana* Sims. *Carex ouachitana* has long rhizomes, which enable the plants to form large stands that often dominate forest floors. Hence, though local, *C. ouachitana* is often abundant where found.

All of the above-cited collections are new county records. The Garland and Perry County collections are the easternmost for the species. The Cherokee, Madison, and Washington County collections are the northernmost and especially significant because they are the first from outside the Ouachita Mountains. These northern records extend the range of *C. ouachitana* to the Boston Mountains.

16. **Carex prasina** Wahl.

MISSISSIPPI. Montgomery Co.: 2 mi W of Winona, 14 Mar 1990, *Bryson 8724 & Newton* (ctb).

A population of about thirty large clumps of this species grew in a springhead seepage above a small stream. The site was forested with *Acer* sp., *Carya* sp., *Fagus grandifolia* Ehrh., and *Quercus* spp. *Carex prasina* was previously known in Mississippi from only Monroe County in the Tennessee River Hills region (Bryson 1984). The Montgomery County collection is from the North Central Plateau region.

17. **Carex socialis** Mohlenbr. & Schweg.

ALABAMA. Morgan Co.: about 12 mi E of Hartselle, 19 May 1934, *Harper 3227* (MO). ARKANSAS. Jackson Co.: W of Jacksonport, hwy 69 at the Black River, 27 Apr 1989, *Jones 2535 & Jones* (MICH, TAES); Jacksonport, near the White River, 14 May 1989, *Naczi 2170* (MICH). Sevier Co.: 1.5 mi S of Horatio, 5 Jun 1989, *Reznicek 8493 & Naczi* (MICH). GEORGIA. Burke Co.: 7 mi NE of Shell Bluff, 18 May 1989, *Naczi 2192* (ctb, GA, MICH, NCU, VDB). MISSISSIPPI. Clay Co.: 3.5 mi W of West Point, 18 May 1982, *Bryson 3317* (ctb). Lowndes Co.: 12 mi S of Columbus, 8 May 1973, *Bryson 164* (ctb); 2 mi ENE of Columbus Lock and Dam on Tenn-Tom Waterway, 13 May 1980, *Hall s.n.* (ctb); just W of Columbus, 1 mi W of old US hwy 82 bridge, 13 May 1980, *Hall s.n.* (ctb); 10 mi S of Columbus, N of Camp Henry Pratt, 12 Apr 1982, *Bryson 3175* (ctb); 10 mi S of Columbus, Aliceville Lake on Tenn-Tom Waterway, 11 Apr 1987, *Bryson 5333* (ctb). Newton Co.: 4 mi E of Newton, S of US hwy 80 along Turkey Creek, 8 May 1982, *Bryson 3254* (ctb). OKLAHOMA. McCurtain Co.: 6 mi S of Broken Bow, 18 Apr 1954, *Waterfall 11816* (MICH). TEXAS. Bowie Co.: ca. 10 mi W of Bassett, 11 May 1987, *Naczi 1568* (MICH). Red River Co.: ca. 4 mi SE of Johntown, 11 May 1988, *Naczi 1867* (ctb, MICH). Walker Co.: Stubblefield Lake, Sam Houston National Forest, 5 Apr 1972, *Wilkinson 691* (srh).

Carex socialis was growing in heavy clay alluvium on floodplains forested with hardwoods at each of our collection sites. At every one of the populations we have observed, *C. corrugata* was a close associate. Additional carices at two or more localities were *C. grayi* Carey, *C. hyalina*, and *C. intumescens*.

Carex socialis has been reported from only a few counties in Alabama (1 county: Kral 1981), Illinois (4: Mohlenbrock 1986), Indiana (4: Homoya & Abrell 1986), Kentucky (3: Heineke & Woods 1987), Mississippi (2: Carter, Morris, & Bryson 1990), Missouri (1: Mohlenbrock & Schwegman 1969), Oklahoma (1: Taylor & Taylor 1989), South Carolina (1: Homoya & Rayner 1987), and Tennessee (5: Webber & Ball 1984;

Guthrie 1989). The collections we cite are new county and state records that increase the known range of this sedge and affirm Homoya & Rayner's (1987) contention that *C. socialis* is more widespread and common than indicated by collections known to them. Harper's Alabama collection is apparently the second for that state and, like Kral's record, in the Interior Low Plateaus physiographic province. Homoya & Rayner (1987) report *C. socialis* from Arkansas, but cite no specimens. Our Arkansas records, apparently the first published ones for the state (Smith 1988), are from the Delta region of the Coastal Plain (Jackson County) and the West Gulf Coastal Plain (Sevier County). Jones & Coile (1988) do not list *C. socialis* for Georgia and our collection appears to be the first for that state and the second for the Atlantic Coastal Plain (Homoya & Rayner 1987). Recently recorded from the Delta region of Mississippi (Carter, Morris, & Bryson 1990), the Mississippi collections cited above are from the Jackson Prairie and Black Belt regions of the Coastal Plain. Taylor & Taylor (1989) report *C. socialis* as new to Oklahoma, listing it from the West Gulf Coastal Plain of McCurtain County. Waterfall's specimen is an earlier record from the same region. The Texas collections, all from the West Gulf Coastal Plain, appear to be new state records (Stanley Jones pers. comm.). Previously published records and the specimens we cite indicate that *C. socialis* is a widespread species, inhabiting the Coastal Plain and Interior Low Plateaus from South Carolina west to Texas and north to southern Indiana, southern Illinois, and southeastern Missouri.

18. **Carex striatula** Michx.

ARKANSAS. Drew Co.: Monticello, 21 Apr 1937, *Demaree 14576* (MICH). Hempstead Co.: 2.2 mi NNW of McNab, 18 May 1986, *Naczi 1178* (MICH).

Carex striatula is a sedge of dry-mesic to moist hardwood or hardwood-pine forests ranging from New York to Texas, primarily on the Coastal Plain (Bryson 1980). At the Hempstead County site, a few plants of this sedge grew with *C. digitalis* in moist, sandy loam at the head of a ravine forested with *Carya* spp., *Cornus florida, Liquidambar styraciflua, Pinus* sp., and *Quercus* spp. Both of the collections cited above are from the West Gulf Coastal Plain and are new county records. Known from but two or three counties in Arkansas (Orzell & Bridges 1987; Smith 1988), *C. striatula* is probably more common in the state than the few records indicate because of its presence in nearby parts of Louisiana and Texas (Bryson 1980; Orzell & Bridges 1987).

19. **Carex trichocarpa** Willd.

DELAWARE. New Castle Co.: Granogue, 22 Aug 1986, *Naczi 1470A* (DOV, MICH).

At this site in the Piedmont, *C. trichocarpa* grew in a narrow, dense band along both sides of a stream through a wet meadow. Lacking fruiting culms, this large population was composed solely of the tall (1–1.2 m) vegetative culms with the inner surfaces of the sheath summits red-brown that are unique among eastern North American carices to *C. trichocarpa* (Reznicek & Catling 1985, 1986).

In Delaware, *C. trichocarpa* is known only from a single 1893 specimen collected near the site mentioned above (Tatnall 1946). Several authors (e.g. Mackenzie 1935; Fernald 1950; Steyermark 1963) note that *C. trichocarpa* prefers calcareous habitats. The scarcity of such habitats in Delaware (Tatnall 1946) may explain the rarity of this sedge in the state.

20. Carex umbellata Willd.

MISSISSIPPI. Attala Co.: 3 mi SE of Kosciusko, 12 Apr 1986, *Bryson 4141 & Buchanan* (ctb, IBE, MICH). Lafayette Co.: S of Oxford, 4.2 mi S of intersec. of MS hwys 7 and 6 bypass, 9 Apr 1987, *Bryson 5327* (ctb, IBE). Lowndes Co.: ca. 6 mi NW of Columbus on Columbus Lake up Tibbee Creek off Tenn-Tom Waterway, 19 Apr 1986, *Bryson 4205* (ctb). Noxubee Co.: 14.4 mi W of Brooksville, 10 Apr 1986, *Rettig 1449* (ctb, GA). Oktibbeha Co.: 1 mi E of MS State Univ., 24 Mar 1987, *Bryson 5164, Warren, & Carter* (ctb, IBE, MICH, NLU, VDB). Tallahatchie Co.: ca. 5.8 mi S of Charleston, 21 Apr 1988, *Bryson 7277 & Morris* (ctb). Yalobusha Co.: 2 mi S of Water Valley, 9 Apr 1987, *Bryson 5320* (ctb, MICH), *5321* (ctb, MICH).

Carex umbellata is a diminutive sedge of dry, sandy, open areas and *Quercus–Carya–Aesculus* woodlands. Our records demonstrate that *C. umbellata* is widespread in several physiographic regions in the northern half of Mississippi: edges of the Black Prairie (Lowndes, Noxubee counties), Loess Bluffs (Tallahatchie), North Central Plateau (Attala, Lafayette, Yalobusha), and Pontotoc Ridge (Oktibbeha). Mackenzie (1935) does not include Mississippi in the range of *C. umbellata* and our records appear to be the first for the state of this often overlooked species.

21. Carex virescens Willd.

MISSISSIPPI. Tishomingo Co.: ca. 1.5 mi NE of Mingo, Cave Spring, 27 May 1986, *Bryson 4401* (ctb, IBE).

This collection is from a limestone sink and cave area under light shade of hardwoods and rock ledges in the Tennessee River Hills region. Our collection appears to be the first for Mississippi, since Mackenzie (1935) does not mention the state as part of the range of *C. virescens*.

22. Carex willdenowii Willd.

ARKANSAS. Howard Co.: ca. 8 mi W of Umpire, 17 May 1988, *Naczi 1920* (MICH). Scott Co.: ca. 2 mi N of Y City, 10 May 1989, *Naczi 2127* (MICH, UARK). Sevier Co.: 8 mi E of DeQueen, 10 May 1989, *Naczi 2121* (ctb, MICH, UARK, VDB). OKLAHOMA. McCurtain Co.: ca. 4 mi NE of Idabel, 14 May 1988, *Naczi 1887* (ctb, MICH). TEXAS. [Harris Co.:] Houston, 20 Apr 1872, *Hall 728* (PH).

Carex willdenowii inhabits rich, moist soil of deciduous forests. This sedge grew just upslope from floodplains at all of our Arkansas and Oklahoma localities. Frequent associates of *C. willdenowii* at these sites were *C. abscondita, C. amphibola* auct., non Steud. (*C. amphibola* var. *amphibola* sensu Fernald (1950)), *C. jamesii,* and *C. oligocarpa*.

First reported only recently from Arkansas (Orzell & Bridges 1987; Smith 1988), the Arkansas collections we cite add three counties to the eight previously reported for the state. Like the previous reports, these collections are from the West Gulf Coastal Plain and Ouachita Mountains. The collection from Oklahoma, where it previously was unrecorded (Mackenzie 1935; Taylor & Taylor 1989), is also from the West Gulf Coastal Plain. Halls' collection is the basis of several reports of the species in Texas (e.g. Hall 1873; Mackenzie 1935; Fernald 1950; Gleason 1952), although Correll and Johnston (1970: 335) remarked that "no material has been seen from the state." Recently, Bridges and Orzell (1989a) rediscovered *C. willdenowii* in Texas and found it to be local but widespread in the eastern part of the state.

ACKNOWLEDGMENTS

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M. Wayne Morris, Anton Reznicek, Richard Carter, J. E. Buchanan, T. E. Newton, P. C. Quimby, and Randy Warren with field work. Stanley D. Jones, Jeffrey H. Rettig, Anton Reznicek, and R. John Taylor kindly allowed us to include some of their records in this paper. Vernon McNeilus brought our attention to the specimen of *C. impressinervia* at TENN. Steven R. Hill, Stanley Jones, Robert Kral, Sidney McDaniel, and Constance Taylor generously shared their extensive knowledge of the carices of their regions. We also thank the curators of MISS, MISSA, MO, NCU, PH, SMU, srh, TAES, TENN, TEX, UARK, US, and VDB for loans of specimens or assistance during our visits. Four Block Grants from the Horace H. Rackham School of Graduate Studies of the University of Michigan provided financial support for field work by Naczi. Anton Reznicek critically reviewed the manuscript.

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Bartonia No. 56: 59–60, 1990

OBITUARY

Dorothy Stewart Evert (1907–1990). On January 12, 1990, the New Jersey Pine Barrens lost one of its most fervent champions, Dorothy S. Evert, who died suddenly of a heart attack at Rancocas Hospital in Willingboro, New Jersey.

Born in Riverside, New Jersey, on November 9, 1907, Dorothy lived most of her life in nearby Riverton. There, under the pervasive influence of her mother, she developed a lasting love of plants and beautiful gardens.

A graduate of Glassboro State College, Dorothy taught kindergarten for a short time. She considered graduating from the Arboretum School of the Barnes Foundation in Merion, PA, one of her proudest achievements.

A master judge emeritus of the National Council of Flower Judges, Dorothy pursued her horticultural interests through her membership in the Garden Club of New Jersey, the Pinelands Garden Club of Medford, the Holly Society of America, and the Pennsylvania Horticultural Society. She had been a member of the Philadelphia Botanical Club since 1957.

In December 1957, Dorothy became the secretary of an advisory committee to the New Jersey Department of Conservation and Economic Development on botanical matters pertaining to the development of the Wharton Tract (now Wharton State Forest). Among those initially comprising this dedicated group of field naturalists known as the Pine Barren Conservationists were Frank and Bob Hirst, Brooks Evert, and several now-departed members of the Philadelphia Botanical Club: Ruth Allen, David Fables, John Gill, Lou Hand, and George Nicklas. Upon the death of chairman Fables in 1961, Dorothy assumed leadership of this group, which already had joined forces with the New Jersey Audubon Society and other conservation organizations in opposing the siting of a jetport in the Pinelands.

Dorothy's tenacity for protecting the Pine Barrens was shared by her husband Brooks, an outstanding nature photographer. For the Everts it was a momentous occasion when in 1967 the Pinelands they so strongly promoted and defended became their home, as they moved to Birchwood Lakes in Medford Township. In the early 1960s, the couple—he as chairman and she as a member of the Citizens' Committee to Save State Lands—worked tirelessly to prevent development of land that had recreational or ecological significance. Dorothy frequently presented slide-illustrated lectures throughout New Jersey especially to conservation organizations, schools, and garden clubs to nurture public awareness of the unique ecological values of the Pine Barrens. In 1965 with the formation of a Pine Barrens National Monument Committee, Brooks and Dorothy, as chairperson and member, respectively, played a notable role in securing national recognition for the region and in mobilizing the National Park Service to undertake ecological studies there. A colorful promotional brochure they had helped to write and design has become a collector's item. Brooks and Dorothy's efforts, and those of their associates, were not in vain: 1978 saw the creation of a Pinelands National Reserve, our country's first national reserve.

As fate would have it, twelve days after Dorothy passed away, Brooks died of a heart attack on January 24, 1990. Up to their sudden deaths at age 82, both had remained active in local environmental issues and in the work of the New Jersey Conservation Foundation.

They are survived by a son, Peter S. of Riverton; two daughters, Constance E. Bring of Brookville, MD, and Barbara E. Whitbred of Cassonova, VA; seven grandchildren and three great-grandchildren.

According to their wishes, Brooks and Dorothy's ashes are to be scattered at Bucks Run, near Martha Furnace, a Pine Barrens spot of unparalleled beauty deeply cherished by both. TED GORDON

Bartonia No. 56: 61–63, 1990

REVIEWS

Atlas Florae Europapaea: Distribution of Vascular Plants in Europe, edited by Jaakko Jalas and Juha Suominen. Cambridge, University Press, New York. 1988 (originally published 1972–1986). 3 vol. I, £30.00; II, £40.00; III, £50.00.

This project, when completed will provide a valuable adjunct to *Flora Europaea*. The enormity of the task is indicated by the fact that the three volumes presently available only cover the taxa included in the first half of volume I of the flora.

The atlas volumes are beautifully done with easy to read and clearly identified maps for each taxon. Plant distribution is mapped using a 50 km grid covering the whole of Europe. While this obviously does not provide high resolution in any specific area it does give a good overall view of species occurrence. Occurrence of a taxon in the area covered by a grid cell is indicated by a symbol which specifies native occurrence, introduction, extinct, probably extinct or uncertain status. Unfortunately the treatment of the Gymnosperms with regard to native species which are also cultivated is not consistent with the way other groups are handled. For example, *Pinus nigra* (maps #164–167, Vol. I), is mapped only in its native range in southern Europe despite the fact that it is widely planted throughout northern Europe. *Quercus cerris*, on the other hand (map #294, Vol. II), is shown as native to southern Europe and introduced in France and Great Britain.

Where species distributions are limited, only the relevant portion of the base map is shown. This manner of presentation allows for pleasing variations in page layout. A helpful addition to each volume, for those of us whose European geography isn't quite up to snuff, would have been a reference map with the countries named. Volumes I and II also lack an explanation of the geographical abbreviations used in the atlas as well as in *Flora Europaea*, but this omission was remedied in Volume III.

In addition to the maps, the atlas volumes include explanatory notes and references for each entry. The nomenclatural treatment of *Flora Europaea* has been updated (Volume I of the flora was published in 1964), and changes are accompanied by explanatory notes and reference citations. The distribution information from the flora has also been updated and expanded. References are included to sources of worldwide distribution data for each taxon.

By presenting distribution information in a graphic format, the atlas greatly facilitates our understanding of elements of the European flora. It belongs in every botanical library next to *Flora Europaea*, which it has been designed to complement, even to the extent that the volumes are the same size. ANN F. RHOADS

Collecting, Processing and Germinating Seeds of Wildland Plants, by James A. and Cheryl G. Young. Timber Press, Portland. 1986. 236 pp. $24.95.

Whether the primary interest is introducing new plants to the garden or to cultivation, growth of plants for research, or growth of rare and endangered plants for conservation and reintroduction, both amateur and professional botanists are often faced with the task of germinating seeds. This task can be formidable since seeds vary in rates of development, duration of viability, and a host of other requirements for germination, including oxygen, light, and water availability. The seed may be maintained in a dormant state by immaturity of the embryo (requiring after-ripening), a tough seed coat (requiring mechanical, chemical or enzymatic scarification), hormonal or chemical inhibition (requiring leaching), a closed fruit (requiring fire to induce opening!) or the lack of suitable germination conditions (calling for stratification, light, or a combination of all of these). A very readable and informative introduction to this difficult area is found in James and Cheryl Young's *Collecting, Processing and Germinating Seeds of Wildland Plants*.

The early chapters of this compact book describe the structure and development of a typical seed and include a chapter with guidelines for the collection of seed to assure the greatest success in germination (although the grower may have little control over this phase of the project). These are followed by techniques and equipment for cleaning and processing harvested seed, and seed storage principles and practices. One of the most valuable chapters covers general principles of seed germination, which describes various techniques used to coax recalcitrant embryos into growth. This chapter is concluded by a diagram of successively more rigorous approaches for the establishment of a successful germination protocol for species where no previous work can serve as a guide. A short chapter on seed purity testing and lot certification practices concludes the background and principles portion of the book.

The bulk of the remainder of the book is a compilation of information and procedures for the germination of the seeds of specific genera and species. This section is divided into chapters covering broad categories: trees, shrubs, herbs, and grasses. Within each chapter the genera are listed alphabetically along with a brief description and some uses of the plants. Some germiantion recommendations are general, but there are also often specific techniques found successful with a particular species or when a species is generally harder or easier than most in the genus to germinate.

The end of the book includes a short glossary, a summation of the species described listed by growth form, family, genus, and species (of little taxonomic value and a bit superfluous), and a complete index. One of the very great values of the book are the extensive references, leading the person with more than a passing interest into the enormous literature of this area. One of the more valuable resources listed is *The Bibliography of Seeds*, a tome which merely lists all papers published up to 1968 which discuss the germination of any of hundreds of species.

The shortcoming (and strength) of this book is the limited coverage, although the authors have attempted to cover a majority of the plants which have horticultural, ecological or conservation value, and which have also been adequately studied to make recommendations. This limitation, combined with the chapter on general recommendations (a plan of attack for the unstudied species), make this book much more manageable than *The Bibliography* and certainly more useful than the most recent edition of a book on the same topic, *The Germiantion of Seeds* (4th ed.) by Mayer & Poljakoff-Mayber.

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JOHN R. PORTER

Sir Joseph Banks, 1743–1820, by Harold B. Carter. British Museum (Natural History), London. 1988. xi + 671 pp. £50.00 (hardbound).

Sir Joseph Banks (1743–1820). A Guide to Biographical and Bibliographical Sources. St. Pauls Bibliographies, Winchester, in association with British Museum (Natural History), London. 1987. 328 pp. £45.00.

For 25 years Harold Carter "unravelled the multifarious threads" of a tapestry, not only of botany, Banks' first affection, but of commerce, geopolitics, admonition for kings, advice for voyagers, treasurer for expeditions, support for authors, the helmsman-arbiter for the Royal Society. Carter says he re-composed more than 15,000 items "into a skeletal structure on which the flesh of more particular themes may now be hung." He insists "clearly, this is not a work of professional biography." Yet from the Ribblesdale beginnings in 1630 the life of Banks is detailed in minutiae through 25 chapters to his death in 1820 when he was designated "The Rt. Hon., Sir Joseph Banks, BT, PC, GCB, PRS, FSA."! Carter says Banks "sought neither an inflated place in history, nor the role of host to the literary parasites of his own or later times." Early in his life Banks was slanderously dubbed "the great Panjandrum of British Science," a Maecenas, or a gouty autocrat. Seven contemporary caricatures, listed by Carter, called him a "fly-catching" dandy, or the "Great South-Sea Caterpiller," unjustified in Carter's view.

This monumental compendium and its complementary Guide will be indispensible sourcebooks on Banks. Fortunately the analytical index of 54 pages set in three columns is excellent. Persons are identified there who are sometimes left shadows in the text. Also the abundant quotations from letters and documents carry no documentation—Carter considered it "supererogant" to do so—and the Guide, being a chronological listing of references by subject, mostly without annotations that would have been helpful, is not a substitute for notes on sources.

There are entertaining episodes in Banks' story as Carter tells it with Banks as shepherd of the flock. Carter has done away with the ha-ha separating the pastures. And it is not all sheep and botany. After Banks visited William Herschel at Dachet to see his telescope, he offered him a pair of old shoes for those nights he was observing Uranus. To accomodate the differences in the size of their feet, Herschel wore seven pairs of stockings "in his night vigil of the stars as some protection against the intense cold when the temperature fell to 7°F and threatened to crack the great speculum of [Herschel's] telescope" (p. 179).

After withdrawing from sailing with Cook on his second voyage, Banks lead the expedition to Iceland on the brig *Sir Lawrence* in 1772. Enroute the party described Fingals Cave for the first time; Solander and John Frederick Miller, artist, were with the party. Regarding Iceland's Mount Hekla: a steaming vent at the very top was "much too hot for sitting on." On several occasions we may wish for a pen portrait of the servants who waited on Banks. For example, Peter Briscoe served Banks on the *Niger* to Newfoundland, the *Endeavour* around the world, and to Iceland on *Sir Lawrence*. Carter tells us the names of the two horn players, John Merchant and Robert Holbrooke, enlisted by Banks for the aborted Cook second voyage. Such are the minutiae Carter provides, to dispel the "faintly etched" figure of Banks.

We may ask: whither now? Charles Blagden (1748–1820) awaits his Boswell. Almost precisely Banks' contemporary, Blagden served as medical officer on the *HMS Pigot* during the Revolution, cruising the American coast from Charleston to Newport, Rhode Island. The 365 letters that passed between them purvey gossip, sketch the American scene, and report on the flora and fauna, as indicated in Warren Dawson's *Banks Letters* (1958). From Blagden's Paris residence and his eaves-dropping at Banks' breakfasts at Soho there will be a kaleidoscope of Anglo-Franco-American history to be enjoyed.

And much more in this Carter *omnium gatherum* of the life and times of Joseph Banks. JOSEPH EWAN

Bartonia No. 56: 64–71, 1990

NEWS AND NOTES

ADDITIONS TO THE LIBERTY STATE PARK PLANT LIST. A few additional plants recorded at Liberty State Park, N.J. (see *Bartonia* 55, Pp. 47–52) during 1989 include *Verbena simplex, Erodium cicutarium, Berteroa incana, Rhamnus frangula,* and *Heliotropium curassavicum*. This last species, an uncommon waif from tropical America, was last recorded from New Jersey on "ballast at Communipaw" (now Liberty State Park) in 1880 by Addison Brown. It was found growing on damp cinder ballast, near shore but well above high tide line. Only eight plants were present. KARL ANDERSON

LEUCOSPORA MULTIFIDA IN NEW JERSEY. During a June 25 Torrey Botanical Club field trip to the Raritan Center business park in Edison Township, Middlesex County, an unusual plant was found growing profusely in a ten-foot long crack in an asphalt parking lot. Subsequent study showed it to be *Leucospora multifida* (Michx.) Nutt. (*Conobaea multifida* in *Gray's Manual*). This midwestern member of the Scrophulariaceae is a diffusely branched annual herb with opposite, deeply pinnatifid leaves, and small (ca. 4 mm long) pale blue flowers. There are no 20th century New Jersey records of this plant at PH, CHRB, or NY. KARL ANDERSON

NEW JERSEY PLANT CHECK LIST. A third revision (1989) of the publication *A Check List of the Plants of New Jersey* compiled by Karl Anderson, has been issued by the New Jersey Audobon Society. It lists 2,695 species that have been recorded from New Jersey, and indicates whether they are native or introduced. The nomenclature follows Kartesz and Kartesz (1980), and Fernald's (1950) names (where different) added in parentheses. This 60-page publication can be purchased by sending $6.00 to the Rancocas Nature Center, RD 1 Rancocas Road, Mount Holly NJ 08060. A copy will be sent postpaid. KARL ANDERSON

NOTEWORTHY DISCOVERIES ON THE NEW JERSEY COASTAL PLAIN. While on a Club field trip on 5 August 1989, I discovered 5 or 6 plants of *Eupatorium capillifolium*, Dog Fennell, growing along a road shoulder near West Creek Cemetery less than 3.5 miles east of Leesburg. This marks the first time this critically imperiled thoroughwort—known also from Cape May County and from an historic record on ballast in Camden County—has been reported from Cumberland County, an extension of its current northern limit of range. On our visit the plants' welfare was threatened by a paving and road-widening project. Based on his subsequent visit to the site, David Snyder, botanist of the New Jersey Heritage Program, reported that all roadside habitat had been destroyed. One can hope that a wider search of this vicinity next season will again turn up this rare taxon.

On a Club field trip of 19 August 1989, *Eriocalon parkeri* was discovered by the writer on the intertidal mudflats along Rancocas Creek in Willingboro's Mill Creek Park, Burlington County. Scattered plants were growing in association with *Scirpus smithii, Isoetes riparia,* and *Eleocharis erythropoda*. At the very edge of high tide were *Lysimachia hybrida* and *Mimulus alatus,* two infrequent species.

Narthecium americanum is generally confined to the heart of the Pine Barrens. Hence discoveries of peripheral populations tend to attract attention. On 1 October 1989, the writer visited a turfcut site a short distance west of Waretown in Ocean County. Upon his initial visit (11 July 1977) he discovered here 4 specimens of Bog

Asphodel in anthesis. To date this population has swelled substantially by means of vegetative as well as sexual reproduction.

In his *Plants of Southern New Jersey,* Witmer Stone questioned a Barnegat record for *Narthecium* quoted by Keller and Brown, referring to it as "apparently entirely erroneous." Based on my knowledge of the region between Toms River and Tuckerton and on my recent discovery of two previously-unreported *Narthecium* sites in the area, I have little doubt that this rare taxon was once present around Barnegat. The Waretown station is just a little more than 3 miles north of Barnegat, while the newest site, discovered on 5 May 1989, just west of Manahawkin is approximately 4 miles south of Barnegat.

West of Waretown in an open, dune-like Pitch Pine forest dominated by *Hudsonia tomentosa* and *H. ericoides* were seen several cushions that clearly exhibited characters intermediate between these two species. Fernald agreed that such intermediate forms look like hybrids, but he was quick to point out that their range extends 2000 miles northwest of the range of *H. ericoides.* TED GORDON

DELAWARE RARE PLANTS SURVEY—FINDING AND RELOCATING RARE PLANTS OF THE PIEDMONT OF DELAWARE. In 1979, the first comprehensive report on the status of Delaware's rare plants was published by Tucker et al. detailing the status of various selected state and national rarities in the state. In 1988, the Delaware Department of Natural Resources, together with the Nature Conservancy, set out to update this report and compile a data base of the rare and endangered species of the state. Several individual and teams of botanists, including members of the Philadelphia Botanical Club, have participated in this survey. In Delaware, the greatest concentration of rare and endangered species is to be found in the narrow strip of Piedmont in northern and northwestern New Castle County, roughly analogous to the strip of Coastal Plain in Pennsylvania for habitat size and diversity. As a result, several botanists worked on this area. The Piedmont team included Ann Newbold, Janet Ebert, Jack Holt, and in 1989 A. E. Schuyler, concentrating on the main drainage areas of the Brandywine, Red Clay, and White Clay creeks in the Piedmont.

In the Brandywine drainage in 1988, the team was able to relocate northern woodland plants such as *Actaea pachypoda, Asclepias exaltata, Diervilla lonicera, Mitella diphylla, Prunus virginiana* (a new state record), *Rubus odoratus, Triosteum perfoliatum,* and *Veratrum viride.* Wetland species found in 1988 included *Eleocharis erythropoda, Juncus torreyi* (new state record), *Mimulus alatus,* and *Spiraea alba*—other rarities found included *Aureolaria flava, Cacalia atriplicifolia, Ceanothus americanus, Hypericum prolificum, Paronychia fastigiata, Polymnia uvedalia,* and *Scirpus verecundus* (a relocation of an earlier Dill & Tucker site).

In 1989, further northern plants found in the Brandywine Valley included *Acer saccharum* (2 sites), *Botrychium matricariaefolium, Corylus cornuta* (at its old historic site) *Hybanthus concolor, Ostrya virginiana, Rudbeckia fulgida, Scirpus purshianus,* and *Taenidia integerrima.* Other rarities included *Bartonia paniculata, Betula populifolia, Conopholis americana, Cuphea viscosissima, Geum vernum* (a new state record), *Glyceria canadensis, Pellaea atropurpurea* (a new state record), and *Zizia aptera.*

Along the Red Clay Creek, we found that the rarities were more concentrated at a few "hot spots" than in the Brandywine Valley, and spent considerable time at these locations. These included the last remnants of serpentine barren habitat left to Delaware. Notable finds in 1988 in the Red Clay drainage included *Aureolaria flava*, a sizable colony of *Equisetum sylvaticum, Eupatorium coelestinum, Liparis lilifolia, Lycopodium clavatum, Rudbeckia fulgida,* and two stations of *Viola rotundifolia*, one consisting of thousands of plants on a steep cool shaded stretch of the creek.

In the Red Clay valley, 1989 relocations included the serpentine endemics *Arabis lyrata* (1 station), and *Cerastium arvense* (2 stations), both unfortunately on roadside banks where there are very susceptible to spraying or mowing. Other notable rarities found included *Amianthium muscaetoxicum, Asclepias exaltata, Caltha palustris, Carex frankii, Ceanothus americanus, Clitoria mariana* in an atypical non-coastal plain habitat, *Dirca palustris* (1 shrub), *Hybanthus concolor, Lilium canadense, Lobelia spicata, Ostrya virginiana, Panax quinquifolius, Pycnanthemum verticillatum, Quercus imbricaria, Ranunculus hispidus,* the new state record *Sanicula trifoliata*, and on the last survey day, *Diervilla lonicera* and *Dryopteris goldiana*.

In the White Clay Creek drainage, 1988 was a productive year for the survey team, partly because of the 1987–1988 White Clay Creek Natural Area survey conducted prior to the start of the Delaware Rare Plants Survey. Rarities encountered during that year included *Agalinis tenuifolia, Aplectrum hyemale, Asclepias exaltata, Botrychium matricariaefolium, Cardamine rotundifolia,* numerous carices, including *C. bromoides, bushii, complanata, frankii, trichocarpa,* the new state record *C. projecta*, large populations of *Gentiana andrewsii* and *Liparis lilifolia, Spiraea alba,* and *Triosteum aurantiacum*. Chris Pattison, a graduate student at the University of Delaware, while involved with unrelated botanical studies, encountered a single specimen of the rare orchid *Platanthera peramoena*. Six plants of this orchid were observed in 1989, including four of which bloomed successfully. Other notable species found in the White Clay drainage in 1989 included the new state record *Alopecurus aequalis, Monarda fistulosa,* and *Woodsia obtusa*.

A number of lesser drainages were also explored by the survey team, including Pike Creek, Mill Creek, Middle Run, Namaans Creek, and the Christina River. A few notable species were located in the course of these explorations, including *Juncus torreyi* and *Poa alsodes* near Namaans Creek in 1989, *Liatris spicata* in the Christina River drainage in 1989, *Lycopodium clavatum* and *Botrychium matricariaefolium* in the Pike Creek Valley, and *Gentiana andrewsii, Liparis lilifolia, Agalinis tenuifolia,* and *Mimulus alatus* in the Mill Creek Valley. However, none of these yielded nearly the number of species found in the three major drainages of the Piedmont in Delaware.

For all the success the Piedmont survey team had in relocating the previously listed rarities, there was a considerable number of species that now appear to be lost permanently for the state in the Piedmont. These include *Adlumia fungosa, Asplenium trichomanes, Dracocephalum parviflorum* (as a native), *Fimbristylis annua, Lilium philadelphicum, Minuarta* (*Arenaria*) *stricta, Platanthera grandiflora* and *psycodes, Polygala paucifolia* and *senega, Potamogeton spirillus, Solidago squarrosa, Thelypteris phegopteris,* and *Triphora trianthophora*. Much of this is due to the usual wetland habitat destruction, and in Delaware's case, the destruction of its only serpentine area through frequent mowing and flooding by the construction of Hoopes Reservoir. As noted earlier in this report as well, several species are just barely surviving in the state. Woodland habitat destruction has accelerated in recent years by housing development construction as some of the old DuPont estates are being broken up. However, a considerable amount of habitat still remains in private and public hands so that the Piedmont of Delaware should avoid suffering the same degree of degradation and destruction as the Coastal Plain of Pennsylvania. JANET EBERT, JACK HOLT, ANN NEWBOLD, ALFRED E. SCHUYLER

A FURTHER NOTE ON THE OCCURRENCE OF *GEUM VERNUM* IN NEW JERSEY. In Bartonia 55: 42–43 I discussed the historical and current status of *Geum vernum* in New Jersey. Although N. L. Britton in his 1889 catalog and M. Y. Hough in her 1983 book considered *G. vernum* to be adventive in the state, I concluded that this assessment was probably incorrect, since both were apparently basing their conclusion only on the 1885 specimens collected by J. E. Peters from a "Princeton roadside" in Mercer County. I argued that Peters probably used "Princeton" loosely to cover a larger collecting range and his specimens may not necessarily have been collected in downtown Princeton. Also, since Peters' initial collections three additional New Jersey locations have been discovered, all supporting a native status. In this note I would like to put on record three additional *Geum vernum* locations discovered during the 1989 field season.

The first I found on 4 May on the seepy bank of a streamlet draining into the Delaware River, located within the Natural Area of Washington Crossing State Park, Mercer County. The species seems native enough at this site. This location is significant in that it is approximately 10 miles WSW of Princeton. While certainly not Peters' location, it does establish that suitable habitat occurs within Mercer County.

A second location was discovered on 23 June on a high bank of the Delaware River, just north of Belvidere, Warren County. It was frequent along a little traveled woods road. In places it grew with *Hydrophyllum canadense,* a rare species in New Jersey which has been collected only along the Delaware River in Warren County.

The third new location for *Geum vernum* was discovered by Ted Gordon growing in the lawn outside the door of his home at Burrs Mill, Burlington County. This site is in a dry oak/pine forest located within the Pine Barrens and quite removed from what could be considered "proper" habitat for the species. It is obviously adventive there—but where did it come from? There are two likely explanations.

Approximately 10 years ago, Ted had a considerable amount of top soil dumped in an effort to establish a lawn. In the intervening years a number of plant species more typical of richer soils have been observed on this fill. Ted's curiosity caused him to track down the source of this soil. As best can be determined it came from Kirbys Mill—an area from which I collected *Geum vernum* in 1988. Personally, I doubt that anyone who is curious enough to attempt to determine the origin of the ground beneath their feet is likely to have overlooked a distinctive plant like *Geum vernum* for any length of time (it's unlikely that 10 years would be required for the species to mature, regardless of whether it was present in the imported soil as either rhizomes or seeds).

I prefer the second explanation which is that the plant "followed" Ted home, either attached to his clothing or dropped from specimens in his collecting bag. As a first hand witness I can testify to the following events. I have observed on a number of occasions Ted scraping off of his clothes great encrustations of *Desmodium* and *Bidens* seeds in the general vicinity of where the *Geum* is now growing. I have also watched Ted root through his specimen bag on the same spot, pulling something out to show or ask a question about. The achenes of *Geum vernum* with their long beaks are easily attached to fur or clothing (where I have observed this plant along trails and roadsides I have been struck by its decidedly linear dispersal). In 1986 Ted and I visted the Vincentown *Geum vernum* site together and both of us collected specimens. Ladies and gentleman of the jury, your verdict please. DAVID SNYDER

EASTERN PENNSYLVANIA NATURAL DIVERSITY INVENTORY 1989 PLANT SURVEY HIGHLIGHTS. The Nature Conservancy's (TNC) Pennsylvania Science Office, a cooperator with Western Pennsylvania Conservancy and the Department of Environmental Resources in the Pennsylvania Natural Diversity Inventory (PNDI), conducted extensive field surveys in 1989. PNDI is part of a network of 76 natural heritage data centers throughout the western hemisphere designed to collect and manage data on species and ecosystems in an integrated system of map and manual files and 30 interrelated computer files. 1989 field work was conducted under grants from the Wild Resource Conservation Fund, Department of Community Affairs, Department of Environmental Resources, National Park Service, Appalachian Trail Conference, and numerous private foundation grants.

In 1989 a total of 238 plant occurrences were observed in eastern Pennsylvania by TNC staff and program cooperators. Intensive countywide inventories in Pike and Wayne Counties searching for relatively undisturbed natural communities, using both large-scale air photos and field investigation, proved to be an excellent method for locating not only natural communities but also new sites for many of Pennsylvania's rares plant species. A total of 85 new exemplary community occurrences and 117 plant species-of-special-concern occurrences were documented for the two counties.

Carex collinsii, state-endangered, was located at one new site in Pike County bringing the total known Pennsylvania populations to three. The population was located near the edge of a swamp dominated by young black spruce and tall shrubs.

Eriophorum tenellum, state-endangered, was also found in Pike County. This represents the only known population of the plant in the state. A small, healthy population of the plant was located on the quaking edge of a small, isolated bog mat within a large conifer swamp.

Carex lasiocarpa, proposed as state-rare, was located at 22 new sites in Pike and Wayne Counties. Almost every population was very small and located in a peatland dominated by one-meter-high *Chamaedaphne calyculata* and *Decodon verticillata*. Most of these *C. lasiocarpa* occurrences were associated with recent flooding by beaver and subsequent nutrient release.

However, the largest population of *C. lasiocarpa* is located in what appears to be a unique community type for Pennsylvania. This site, located north of Starrucca in northwest Wayne County, consists of a large floating mat that has little or no *Sphagnum* growing on it. *C. lasiocarpa* dominates the mat, and a healthy population of *Utricularia intermedia* (Pennsylvania-threatened) is also present on the mat surface. *C. rostrata* and *C. lacustris* are abundant toward the upland margin. Soils within the watershed are described as medium to strongly acid (Martin 1985). Vegetation and soils indicate water chemistry that may be similar to the "rich fen" community described by Glaser (1983) and Glaser et al. (1981) for northern Minnesota.

Cyperus diandrus, a state-threatened species, was located along the moist, gravelly shores of a glacial lake in central Wayne County. This is the only known extant population outside of Presque Isle, Erie County. *C. diandrus* is an annual sedge that can appear unexpectedly along lake margins following a decrease in water level.

Carex paupercula, a state-threatened species, was located at 11 new sites in Lackawanna, Lycoming, Pike, and Wayne Counties, bringing the total known Pennsylvania populations to 19. Most of these sites were floating peat mats of less-disturbed bog communities. In these locations *Chamaedaphne calyculata* grows in a dwarf form reflecting the nutrient-poor conditions.

Carex polymorpha, a state-endangered species and a candidate for listing under the federal Endangered Species Act, was also located at two sites. A population, located in Carbon County, was found distributed along a 1.2-mile ecotone of *Acer rubrum/Osmunda cinnamonea* moist acid woods that contained *Pinus rigida–Quercus ilicifolia/Rhododendron canadense* openings; the moist acid woods graded into a *Picea rubens* peatland across the ecotone. *Lygodium palmatum,* a state-rare species, was also abundant throughout this area. Ann F. Rhoads found a second population numbering several thousand individuals in Monroe County in a *Sassafras albidum/Quercus ilicifolia-Gaylussacia frondosa* community. There are currently seven known extant populations of *Carex polymorpha* in the state.

Juncus gymnocarpus, a state-endangered species, was found in Dauphin and Schuylkill Counties in 1989 bringing the known populations in the state to four. Both new populations were thriving in hillside acid seeps under a *Tsuga canadensis–Acer rubrum–Betula lenta* canopy.

Bouteloua curtipendula, a state-rare species not previously collected from Franklin County (PNDI 1990), was the dominant species growing on a quarter-acre limestone outcrop on the edge of an old field in southern Franklin County.

Tomanthera auriculata, a candidate for federal listing and listed as endangered in Pennsylvania, is known to be extant at only one locality (Regan and Smith 1988). This site was located in 1987 at which time approximately 50 individuals were present. One hundred fifteen (115) flowering individuals were present in 1989.

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ANTHONY F. DAVIS, GREGORY J. EDINGER, THOMAS L. SMITH

A SUCCESSFUL TRANSPLANT OF *CERASTIUM ARVENSE* VAR. *VILLOSUM* TO STATEN ISLAND SERPENTINE. In 1974 I planted 10–12 plants of *Cerastium arvense* var. *villosum* (not the more restricted *C. villosissimum*) in Staten Island that were grown from seed obtained from a serpentine barren in Goshenville, Pennsylvania. They were "leftover" from my dissertation research on serpentine barrens at the University of Pennsylvania.

The main ridge of Staten Island, New York consists of serpentine rock which at one time bore a distinctive flora that shared species with the Pennsylvania serpentine plant communities. *Cerastium arvense* var. *villosum* was one of the species shared (Hollick and Britton 1887), but this species and its associates disappeared as Staten Island became urbanized (Weingartner, personal letter 1971). The Staten Island Expressway cuts through serpentine bluffs near the Todt Hill Exit. I explored these bluffs during a visit to my aunt who lived nearby. They were fenced from adjacent residential development, probably for safety reasons. The top of the bluffs were sparsely vegetated with *Schizachyrium scoparium* and a variety of weeds. I planted the *Cerastium* plants near the edge in a particularly stony sparse area. I visited the plants six years later just before I moved to Florida. They had spread to cover an area about 1.5 m in diameter.

In April 1988 I asked Dick Buegler, an active member of the Torrey Botanical Club in New York who lives in Staten Island, if he would check on the plants. I received the following report in a letter dated April 28, 1988.

> "After supper tonight, at about 8 p.m. I drove from my home near the Bradley Avenue exit toward the Verrazano Bridge . . . I spotted a grassy, treed area to my right that I knew had to be your site. I looped back onto the local roads and from a hole in the fence . . . I crossed to the plant's site. You should have been with me because you would have been delighted to see what has occurred in the intervening eight years. There are now thousands of plants.
>
> The Cerastium plants are found in at least six different colonies. Four smaller colonies measure approximately 7 × 12, 3 × 15, 2 × 3 and 4 × 7 feet. The two large ones are approximately 25 × 50 and 30 × 60 feet, all of them within less than a hundred feet of each other. The original site is approximately 25 × 50 feet. The best stand is south of the original site and covers a southwest sloping site. In some areas the colonies are somewhat sparse, but generally they have formed a fairly thick, continuous dense mat with the vigorous flowering shoots poking above. It's apparently in full bloom now."

Kruckeberg (1986) reported the deliberate introduction of 27 individuals of *Silene paradoxa,* native to serpentine and calcium substrates in southern Europe, to a serpentine barren in western Washington in 1964. These plants grew to a population of nearly 1000 plants by 1983. Human introduction of new species to a native flora is risky. Alien species may replace less aggressive native plants that often have to contend with pathogens and predators that do not affect the non-native.

Kruckeberg's site was a "barren habitat devoid of other plants," so no native plants were displaced. *Cerastium arvense* var. *villosum* was planted in a region and habitat type that it formerly occupied. If preserved serpentine sites in Staten Island are available, Pennsylvania serpentine barrens can be used as donors for other transplants. These transplants could be conducted as scientific experiments to study demography, colonization, and competition among serpentine plants and to observe how a plant community develops.

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ROBIN HART

THREE NEW TAXA FOR THE DELMARVA PENINSULA. I found *Litsea aestivalis* in June, 1985, in Wicomico County, Maryland, about 10 miles west of Salisbury. It was growing in an open woodland pond surrounded by pine oak forest. There were great huge clumps of both male and female individuals present. One or two specimens were 10 to 15 feet wide and over 8 feet tall. Well over 25 separate shrubs or groups of stems. The pond itself was about ¾ of an acre in size and a little deeper than the few other similar ponds I know of in Maryland. It held about 8 inches of water one dry summer when all else was dry. In the spring of 1985 the water was 24 inches deep. In 1986 it was bone dry that fall. Surprisingly, to date, no other rare plants have turned up with this southern shrub. *Litsea* is rare in North Carolina, the next state south with an extant station. It was known in southeastern Virginia but is now considered extirpated there. The associates are: *Carex striata, Dulichium arundinaceum, Proserpinaca pectinata,* *Scirpus cyperinus, Rhexia virginica, Juncus repens, Leucothoe racemosa, Vaccinium atrococcum, Cephalanthus occidentalis, Clethra alnifolia, Rhododendrom viscosum* and *Panicum spretum. Litsea* covers about 10–15% of the pond.

Zephyranthes atamasco is fairly common in Southeastern Virginia (C. Ludwig pers. comm.) but never apparently reported north of Chesapeake Bay. I first saw the leaves of this plant back in 1982 east of Snow Hill in Worcester County, Maryland. I was plant hunting in one of the local rich woods pockets, a rare phenomenon on the outer Coastal Plain. There were no flowers then and a few repeated trips to watch it revealed nothing but vigorous leaves which were very strange and unfamiliar to me. The plants were a mystery with no flowers for seven years. This year, 1990, Ron Wilson and I started an inventory of the woods, and after the wettest, rainy spring in many years, Ron finally saw the plant flowering on May 17th. A few days later we were delighted with well over 100 beautiful large white flowers. In the South *Zephyranthes* is called the Rain Lily and it proved to live up to its name here in Maryland. The area is quite natural with some very interesting rich Piedmont type plants. A few important associates are: *Galearis spectablis, Sanguinaria canadensis, Dentaria laciniata, Claytonia virginica, Obolaria virginica, Viola sororia, Oxalis violacea, Carex rosea, Carex styloflexa* and *Carex laxiculmis.* We have recorded about 30 plant taxa from this small five acre spot that are absent or extremely rare in the acid Coastal Plain.

Schizaea pusilla is a new addition to Delaware's flora. This tiny rare fern was discovered while searching stream corridors for the Delaware Heritage Program. On June 20, 1990, accompanied by Ron Wilson, and fighting our way through a fairly dense cedar swamp, west of Milton in Sussex County, we came upon a small (¼ acre) open, cedar bog. Struck by the similarity of a New Jersey Pine Barren cedar bog, we stood fascinated by the beautiful blooms of *Calopogon tuberosus* and *Pogonia ophioglossoides* and sparkling patches of *Drosera* leaves. The whole bog was spotted with small tumps or hammocks supporting small white cedars. The sedge, *Rhynchospora fusca* caught my eye and then the small graceful fertile fronds of the Curly-grass. The area was very fragile and we hated to step on the tumps but we did manage to carefully survey a good portion and found the fern very abundant. Some tumps had over a dozen or two fruiting fronds. There were perhaps over a couple hundred plants in this small spot. Some other associates were: *Eriocaulon septangulare, E. compressum, Juncus militaris, Scirpus subterminalis, Utricularia fibrosa, Carex exilis, Cladium mariscoides, Drosera rotundifolia, Xyris smalliana* and a tall *Platanthera,* not yet flowering. Mostly all of the taxa are on Delaware's list of "plants of special concern" and are rare statewise. Many of the species in this bog are at, or near, their most southern range. **Frank Hirst**

Bartonia No. 56: 72–78, 1990

1989 FIELD TRIPS

April 29: Shaws Mill Pond/Bear Swamp West, Cumberland Co., NJ. The field trip season got off to a soggy start as heavy rains were present throughout the day. Our first stop was the Cedar Branch of the Nantuxent Creek, east of Cedarville. Here in a swamp dominated by *Acer rubrum, Chamaecyparis thyoides,* and *Nyssa sylvatica,* we saw an excellent stand of the federally-threatened *Helonias bullata* growing with *Carex collinsii, Lindera benzoin,* and *Rhododendron viscosum.* As we left the swamp we noted a small patch of *Goodyera pubescens* growing along the side of Factory Road. We then visited Bear Swamp West in Downe Township where we followed a footpath along its eastern boundary. We passed through open, moist, grassy areas that were dominated by herbs, including *Aletris farinosa, Andropogon virginicus, Calamagrostis cinnoides, Panicum virgatum, Schizachyrium scoparium,* and *Viola lanceolata.* As we entered forested areas, thick stands of *Smilax rotundifolia* and numerous fallen trees impeded our progress. Once in the forest we noted the high number of oaks that had been killed by gypsy moth infestation. The group was delighted to see a population of *Listera australis* (in bloom) growing in a large patch of *Chasmanthium laxum.* The truly plucky members of the group then crossed a small tributary of the Oranoaken Creek, via a log bridge made exceedingly slick by rain and algae, to see *Phoradendron serotinum* growing on a *Nyssa sylvatica.* Leader: Gerry Moore.

May 13: Doe Mountain Ski Area, Montgomery Co., PA. Prior to our Philadelphia Botanical Club field trip, 156 species had been recorded from this area. After our day there, the number was increased to 209. Among the plants we saw were: *Polygala paucifolia, Aster lowrieanus, Castanea dentata* with some genuine chestnut hulls at their feet, *Pycnanthemum incanum, Isoetes englemanni, Pyrola elliptica, Silene stellata, Cypripedium acaule, Descurainia pinnata.* The hillside holds both *Betula lutea* and *B. lenta.* The Perkiomen Valley Watershed Botany group joined the group and long-time member of both groups, Betty Derbyshire, honored us with her presence. On the way home a few of us stopped to see a patch of *Trillium erectum.* We all decided to go back in December to ski. Leader: Val Udell and Ann Newbold.

May 20: Bowman's Hill Wildflower Preserve. This field trip could have been considered a grand tour of the Preserve, and our ultimate goal was to see every species that was expected to be in bloom on this day. May blooming guides were handed out and participants eagerly checked off each flower as they were identified. Species encountered include the following: *Phlox divaricata, Phacelia purshii, Silene virginica, Phlox stolonifera, Dicentra eximia, Zizia aurea, Senecio aureus, Duchesnia indica, Ranunculus bulbosa, R. septentrionalis, Viburnum prunifolium, Peltandra virginica, Osmunda cinnamomea, O. claytoniana, Cardamine bulbosa, Asarum canadense, Chrysogonum virginianum, Sedum ternatum, Thalictrum dioicum, T. thalictroides, Cypripedium pubescens, Tiarella cordifolia, Camassia scilloides, Viola lanceolata, Sarracenia purpurea, Cerastium arvense, Taenidia integerrima, Lupinus perennis, Iris cristata, Maianthemum canadense, Rhododendron periclymenoides, R. prinophyllum, Hesperis matronalis, Oxalis violacea, Erigeron pulchellus, E. philadelphicus, Viola pedata, Podophyllum peltatum, Viola palmata, Antennaria plantaginifolia, Hydrophyllum virginianum, Trillium luteum, Aristolochia macrophylla, Actaea pachypoda, Viola striata, Hypoxis hirsuta, Aralia racemosa, A. nudicaulis, Viola canadensis.*

Special thanks goes to John Feeney, Bowman's Hill Wildflower Preserve summer intern, for compiling species list. Leader: Greg Edinger.

May 21: Stratford Marls, Camden County, NJ. This trip was in an area that has not been botanized for some time because suburban development has all but destroyed most natural communities. We investigated a narrow strip of rich woodlands behind numerous homes.

The site lies over a glauconitic marl band that produces soil conditions much different from lands to the east and west. The forest was dominated by *Quercus alba, Quercus rubra* and *Fagus grandifolia*. Our observant band of botanists discovered eleven species of *Carex* (*Carex pensylvanica, rosea, blanda, cephalophora, debilis var. debilis, laevivaginata, swanii, nigromarginata, annectens, laxiculmis, emmonsii*), four species of *Viburnum* (*dentatum, prunifolium, acerifolium, rafinesquianum*) and other interesting plants that included *Festuca obtusa, Sphenophlis nitida* and *intermedia, Aster prenanthoides* and *divaricatus, Corylus americana,* and *Scirpus verecundus*. After a morning's walk in this woodland we moved to a high, eroded point between the Timber Creek and Signey Run. This area gave the group a nice vista of the tidal portion of the Big Timber Creek. Here, we saw plants similar to the earlier site, but with a drier aspect. Additionally, we investigated a small burned area and remarked on its similarity and difference with burns in the Pine Barrens. Leader: Joe Arsenault.

June 4: wet woods and ponds, Riddleton, Salem Co., NJ. Hiking along on old railroad grade toward what used to be Riddleton, we examined trees that appeared to be hybrids between *Quercus phellos* and *rubra*. We looked at carices in the wet woods and then continued along the railroad grade that was covered with dense stands of *Callitriche terrestris* in some places. We stopped to compare plants of *Viburnum dentatum* and *recognitum* growing side by side and wished that they were always so readily distinguishable. After much bushwhacking to locate the pond with *Hottonia*, we finally found it easily accessible from the railroad grade. There were two stands of *Hottonia inflata* in water over one meter deep, one about 5 × 5 meters and the other about 13 × 2 meters. *Torreyochloa pallida* was abundant in the pond and scattered trees of *Quercus lyrata* were in water at the pond's edge. Leader: Alfred E. Schuyler.

June 10: Tuckahoe River Area, Atlantic, Cape May, Cumberland cos., NJ. In a wet oak woods, just north of Head of the River Road, we saw the leaves of *Tipularia discolor*. Over thirty leaves were counted and most of these had begun to wither. We then visited an upland oak forest, just south of the Head of the River Cemetery. Here, thanks to the sharp eye of Stephen Field, the group got to see *Malaxis unifolia* in bloom. Despite much searching only one individual was noted. Associate species included *Amelanchier canadensis, Cypripedium acaule, Goodyera pubescens, Ilex opaca, Kalmia angustifolia,* and *Vitis aestivalis*. The group then visited Aetna Furnace where we marveled at a large population of *Liparis lilifolia* in bloom. It was estimated that over 1,000 plants of it were at the furnace site. A few specimens of *Ophioglossum vulgatum* v. *pseudopodum* were also seen. *Carya pallida* was also noted near the furnace site. In a ditch just off of Route 49, east of Hunters Mill, we saw a fine stand of *Carex barrattii*, a globally rare sedge. As we traveled along Hunters Mill Road we saw good populations of *Malus angustifolia* and *Viola brittoniana*, two state rare species. The trip was concluded by following a footpath that meandered through a pine-oak upland and ended in a boggy area near the Tuckahoe River at Hunters Mill. In the pine-oak upland we noted *Stipa avenacea* in fruit. In the boggy area the group got to see a good display of *Pogonia ophioglossoides* and *Calopogon tuberosus* in bloom while listening to the call of pine barrens treefrog (*Hyla andersoni*). Leader: Gerry Moore.

July 1: Tulpehauken Creek at Hawkins Bridge, Wharton State Forest, Burlington County, NJ. After a brief stop at Burnt Bridge just south of Chatsworth to see *Cladium mariscoides* and *Juncus militaris* both in anthesis, *Toxicodendron vernix* already in immature fruit, and *Asclepias rubra* in bud, we tramped the cedar swamps, quaking bogs, and savannas along the Tulpehauken. Among the diverse flora recorded were *Spiranthes gracilis, Pogonia ophioglossoides, Danthonia sericea* var. *epilis, Panicum lucidum, P. mattamuskeetense, Carex exilis, C. collinsii, C. trisperma, C. stricta,* and rarities such as *Carex livida* var. *grayana, Schizaea pusilla, Calamovilfa brevipilis, Muhlenbergia torreyana, Tofieldia racemosa, Narthecium americanum, Rhynchospora cephelantha, R. oligantha,* and *Juncus caesariensis*. During lunch the group was briefly distracted from botanical concerns by the mating calls of Pine Barrens Treefrogs, *Hyla andersonii,* and the approach of two photogenic subjects: a Northern Pine Snake, *Pituophis melanoleucus melanoleucus,* swimming across the stream, and an Eastern Kingsnake, *Lampropeltis getulus getulus*. After lunch those who bushwacked to the upper savannas and risked getting mired to the waist were rewarded by a spectacular floral display of *Narthecium, Tofieldia, Lophiola americana, Lacnanthes tinctoria, Sabatia difformis, Eriocaulon compressum, Utricularia cornuta,* and *U. fibrosa*. Our search for the "lost" *Cleistes* was unsuccessful. Leader: Ted Gordon.

July 15: Tyler Arboretum, Lima, PA. The quest for the *Lilium philidelphicum* was a success! We saw beautiful blooms. We also found some *Isotria verticillata,* which was not in bloom. While touring the Herb Garden and grounds, many rare and unusual trees were observed. At the end of our walk, we stopped at Black Hawk Spring for a cool drink. This was an exceptional day. Leader: John Ballas.

July 29: Oceanville Bog, Atlantic County, and New Gretna environs, Burlington County, NJ. We enjoyed a beautiful, sunny, bug-free morning exploring a little gem in private ownership known as Oceanville Bog. High density development proposed on adjacent land is a threat to this unique ecosystem. To the north of Great Creek Road our search concentrated on the periphery of a treacherous, floating, sphagnous mat. Here we recorded such dominants as *Rhynchospora fusca, R. alba,** *Eleocharis tuberculosa, E. tenuis, Juncus pelocarpus, Triadenum virginicum, Woodwardia virginica,* and fruiting *Pogonia ophioglossoides*. Sphagnum species included *S. fimbriatum, S. torreyanum, S. pulchrum,* and *S. magellanicum*. The yellow flowers of the common *Utricularia fibrosa** and *U. geminiscapa** drew more attention than the verticillate leaves of the infrequent *U. purpurea,* not yet in flower. In the cedar bog to the south of the road, we encountered *Sphagnum flavicomans, Schizaea pusilla, Lycopodium carolinianum, Eriocaulon decangulare**, *Rhexia virginica**, *Utricularia cornuta**, *Asclepias rubra**, *Platanthera blepheriglottis* (4)* *P. cristata* (4)*, and our three native

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* Plants in anthesis.

*Drosera**, growing side-by-side. An isolated, introduced population of Venus Flytrap, *Dionaea muscipula*, appears to have been vandalized. During lunch at the picnic grove of nearby Forsythe (Brigantine) National Wildlife Refuge, we saw the spineless leaf-form of *Ilex opaca* forma *subintegra* and the adventive Windmill Grass, *Chloris verticillata*. Farther north on a brackish marsh along Jobs Creek east of New Gretna, the special attractions were *Kosteletzkya virginica**, *Hibiscus palustris**, *Helenium autumnale**, *Apios americana**, *Sabatia stellaris**, *S. campanulata**, *S. dodecandra**, and *Lythrum lineare**. On a savanna along the headwaters of the East Branch of Bass River about 3.5 miles to the north, *Carex exilis*, *C. collinsii*, *C. atlantica*, *Rhynchospora gracilenta*, *Juncus caesariensis*, *Gaylussacia dumosa*, and *Utricularia subulata* forma *cleistogama** were added to our bounty of the day. Leader: Ted Gordon.

August 5: Manumuskin River, Cumberland County, NJ. The first stop on this field trip was a vernal pond, west of Bennetts Mill. Here we searched unsuccessfully for *Coreopsis rosea*, *Psilocarya nitens*, and *Utricularia purpurea*. We did, however, spot *Scleria reticularis* growing with *Dichanthelium acuminatum*, *Gratiola aurea*, *Rhynchospora alba*, *R. capitellata*, and *Utricularia fibrosa*. We then did some roadside botany along Union Road to see *Desmodium viridiflorum* and *Galactia regularis* in bloom. Along a path leading to the Manumuskin River, near Forge Pond, *Monotropa hypopithys* and *Desmodium laevigatum* in bloom and *Prunus maritima* in fruit were noted. In a hardwood swamp, adjacent to the river, *Platanthera blephariglottis* was seen in bloom. In a nearby boggy area the following species were recorded: *Cladium mariscoides*, *Drosera intermedia*, *D. rotundifolia*, *Lysimachia terrestris*, *Polygala cruciata*, *Rhynchospora chalarocephala*, and *Sarracenia purpurea*. In the river, dense stands of *Scirpus subterminalis* were found growing with the aquatic moss *Fontinalis novae-angliae*. After lunch, the group made a quick trip to an oak-pine upland, near Cumberland Furnace to see a stand of *Clitoria mariana*, a rare legume in NJ. Although we noted many plants that were either in fruit or in bud, we unfortuantely could not find any individuals in bloom. The group then followed a sand path leading through a dry oak upland, just off of Hesstown Road. In the path, we saw *Crotonopsis elliptica*, a rare spurge in NJ, in bloom. The group also noted *Aristida oligantha*, *Gaylussacia baccata*, *G. frondosa*, *Hypoxis hirsuta*, *Oenothera fruticosa*, *Quercus alba*, *Q. coccinea*, *Q. falcata*, *Q. ilicifolia*, *Q. marilandica*, *Q. montana*, *Q. prinoides*, *Q. velutina*, and *Tephrosia virginiana* in this dry forest which is home to an ant species, *Formica exsectoides*, that is rare in southern NJ. The group then followed the railroad tracks, enroute to a freshwater tidal marsh. Along the way, the following species were recorded. *Asclepias turberosa*, *Bulbostylis capillaris*, *Desmodium strictum*, *Ipomopsis rubra*, *Linaria canadensis*, *Toxicodendron toxicarium*, and *Trichostema dichotomum*. In the freshwater tidal marsh, the group got to see a large stand of *Zizania aquatica* as well as a number of rare species, including *Aeschynomene virginica*, *Eriocaulon parkeri*, and *Scirpus cylindricus*. Leader: Gerry Moore.

August 6: Goose Ponds, Egg Harbor, Atlantic County. On this trip, we ventured into the 1 ½ to 2 feet of water in the vernal habitats of the Goose Ponds. We were rewarded with a view of several awned meadow beauties (*Rhexia aristosa*) in flower and a glimpse at *Utricularia olivacea*. Other species observed were *Rhynchospora inundata*, *Panicum hemitomon*, and *Eleocharis robbinsii*. A search for *Eleocharis esquisetoides* proved futile. Another high point of the trip was to see John Ballas get wet! Leader: Bill Olson.

August 12: Colliers Mill Fish and Wildlife Management Area, Ocean County, NJ. On this day, we braved a rainy day to explore the Colliers Mill Fish and Wildlife Management Area. Although there were not a lot of unusual species present, the following were found: *Brasenia schreberi, Monarda punctata,* and *Amphicarpum purshii.* Due to the heavy rain near noon time, some of the participants left early. For those who stayed, we were able to see *Calamovilfa brevipilis.* Also, the disjuncts of more southern ranges were found: *Leiophyllum buxifolium, Xerophyllum asphodeloides* and *Pyxidanthera barbulata.* Leader: Bill Olson.

August 19: Rancocas Nature Center and Mill Creek Park, Burlington County, NJ. The trip began with a visit to a gravelly intertidal area along Rancocas Creek at Mill Creek Park in Willingboro. Some of the plants seen here were *Isoetes riparia, Eriocaulon parkeri, Scirpus smithii, Zizania aquatica, Acorus calamus, Amaranthus cannabinus,* and *Pontederia cordata.* At the high tide line, *Lysimachia hybrida, Mimulus alatus, Helenium autumnale, Hibiscus moscheutos,* and *Sium suave* were found in bloom. Nearby upland woods produced *Physocarpus opulifolius, Humulus lupulus, Lactuca biennis, Virburnum cassinoides, Virburnum lentago, Chrysopsis mariana, Scutellaria elliptica,* and *Hieracium gronovii.* The shore of a small pond had *Eclipta prostrata, Cyperus brevifolioides, Hypericum mutilum,* and *Veronica anagallis-aquatica.* After lunch, a visit was made to the Rancocas Nature Center in Westhampton, where *Magnolia tripetala, Magnolia virginica, Itea virginica, Scutellaria integrifolia, Lobelia cardinalis,* and *Agrimonia microcarpa* were noted along the trails. Leader: Karl Anderson.

August 20: Bennett Bog, Cape May County, NJ. Due to unusually high amount of precipitation this year, Bennett's Bog has been under water since January. This has caused an absence of some species while also causing an increase in other species. Absent this year were species such as *Platanthera nivea, Manisuris rugosa* and many of the annual grasses and sedges. In increase this year are species such as *Eleocharis melanocarpa, Eleocharis quadrangulata,* and *Utricularia radiata* (*inflata var. minor*). We walked through the 1 ½ feet of water to explore this habitat which was quite different than last year's excursion here. It will be interesting to observe if this wet year will cause any differences in next year's vegetation. Leader: Bill Olson.

September 2: Bogs of Wells Mill and Forked River environs, Ocean County, NJ. While the cedar bogs along lower Oyster Creek have been degraded by thermal pollution from a nuclear power plant or have been expunged or impacted by industrial and housing development, those in the upper reaches of Wells Mill still are in a relatively pristine state. There, a tiny, spring-fed bog by a wooden bridge below the millpond harbored a fine representation of the family *Cyperaceae: Eleocharis tuberculosa, E. tenuis, E. olivacea, E. robbinsii, Carex exilis, C. folliculata, C. walteriana, Rhynchospora alba, R. capitellata, Cyperus dentatus, Dulichium arundinaceum, Eriophorum virginicum, Scirpus cyperinus,* and *S. subterminalis* (fruiting abundantly). Only five rushes occurred: *Juncus canadensis, J. pelocarpus, J. marginatus, J. effusus,* and the rare *J. caesariensis.* Along a roadcut nearby and downstream we saw two disjuncts, *Xerophyllum asphodelloides* and *Pyxidanthera barbulata,* the orange drumheads of *Polygala lutea, Calamovilfa brevipilis, Scleria minor,* and *Rhynchospora gracilenta.* Along a feeder branch about 1.5 miles to the northeast, these six species were seen again in a turfcut—a unique niche from which turf is beliefed to have been removed by colliers to cover their charcoal kilns. Additional species noted here were *Schizaea pusilla, Lycopodium carolinianum,* the disjunct *Leiophyllum buxifolium, Amphicarpum purshii, Scleria triglomerata,* and *Paspalum ciliatifolium.* We concluded our botanizing at Enos Pond along a feeder of the North Branch of Forked River. Among the diverse assemblange recorded here were *Gratiola aurea, Fuirena squarrosa, Platanthera clavellata, Juncus biflorus, J. scirpoides, Sabatia campanulata, S. stellaris, Helenium autumnale, Eryngium aquaticum, Muhlenbergia uniflora, Helianthus angustifolius,* and *Solidago stricta.* We saw several immature specimens of a *Spiranthes* which may have been the rare *odorata,* previously seen at this site by the leader. Leader: Ted Gordon.

September 9: Stafford Forge, Eagleswood Township, Ocean County, NJ. We braved the mosquito infested wetlands around the large impoundments of this New Jersey Fish and Wildlife Management Area. On this excursion, we followed the south and east banks of the first and second impoundments. Here, along the open, wet paths we discovered many common Pine Barren and coastal species so typical of this region. Species of interest included locations for the rare *Rhynchospora knieskernii* and *Eupatorium resinosum,* plus *Utricularia intermedia, Brasenia schreberi, Rhynchospora chalarocephala* and *gracilenta.* After lunch, those that remained drove to Dock Road in West Creek, only to be met with swarms of those pesky Jersey mosquitoes. Leader: Joe Arsenault.

September 16: Tinicum National Environmental Center, Philadelphia County, PA. Highlights of the trip included the following composites: *Helenium autumnale, Helianthus annuus, H. divaricatus, H. tuberosus, H. giganteus, Rudbeckia laciniata, R. serotina, Eupatroium perfoliatum, E. rugosum, E. serotinum, E. hyssopifolium, E. leucolepis,* and *E. rotundifolium.* In addition, many more marsh and coastal plain species were observed. Leader: John Ballas.

September 30: Tuckahoe River/West Creek, Atlantic, Cape May, Cumberland cos., NJ. We began this trip by visiting the Aetna Furnace site near the Head of the River Cemetery. Along the road leading to the furnace the group got to see *Solidago elliottii,* a rare NJ goldenrod, in bloom. Once at the furnace site, orchid fiends were pleased to see a fine stand of *Corallorhiza odontorhiza* in bloom. Nearby, in a freshwater marsh we noted *Eryngium aquaticum* growing with *Bidens connata, Dulichium arundinaceum, Orontium aquaticum, Rhynchospora macrostachya,* and *Zizania aquatica.* We then visited an easement line just off of Route 49 to check a population of the globally rare *Eupatorium resinosum.* The population appeared to be threatened by succession as woody plants, especially saplings of *Acer rubrum,* were starting to dominate. Along the side of Weatherby Road, near its intersection with Route 49, the group saw a stand of *Solidago ludoviciana* in bloom. The group then visited the West Creek area where we got to see a small patch of the rare *Lespedeza stuevii* in bloom. The group then walked to the West Creek Baptist Cemetery. Along the way, Ted Gordon spotted a composite that most of us dismissed as an *Artemisia.* Ted had the last laugh though as it was later positively identified as *Eupatorium capillifolium,* a very rare species in NJ that was previously known to be extant only in Cape May County. It was hitherto unknown from Cumberland County. At the West Creek Baptist Cemetery, the groups' last stop, we saw a fine autumn wildflower display including *Agalinus setacea, Aster concolor, A. linariifolius, A. patens, A. vimineus, Euthamia graminifolia, Liatris graminifolia, Solidago canadensis, S. erecta, S. fistulosa, S. nemoralis,* and *S. odora.* The three common pines of southern New Jersey, *Pinus echinata, P. rigida,* and *P. virginiana* were also noted at the cemetery. Leader: Gerry Moore.

Bartonia No. 56: 79–83, 1990

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Program of Meetings 1989

1989	*Subject*	*Speaker*
26 Jan	Flora of the Delaware Estuary	A. E. Schuyler
23 Feb	Peter Collinson's Natural History Circle in Philadelphia	A. W. Armstrong
23 Mar	Mt. Cuba Center—Developments and Prospects	R. W. Lighty
27 Apr	A Garden in the Sky: Arctic and Alpine Flora of the White Mountains	M. Emerson
25 May	A Short Reach at the Long Table: To Be a Sedentary Organism in a Spatially Heterogeneous Environment	G. Matlack
28 Sep	Centennial Fund Book Sale/Auction and Slide Illustrated Report of Summer Botanizing	Club Members
26 Oct	Plant Succession and Ecosystem Rehabilitation: A Systems View	M. K. Wali
16 Nov	Impact of New Jersey's Flora on Natural Historians	D. E. Fairbrothers
21 Dec	Spring Botany of Okefenokee Swamp, Georgia	W. F. Olson

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Bartonia No. 57: 1, 1992

Centennial of the Philadelphia Botanical Club

The first meeting of the Philadelphia Botanical Club was held December 1, 1891, at the Academy of Natural Sciences with eight founders present. A week later a constitution and bylaws were adopted. The objectives of the new club were "to further the interest of Botany and to make a checklist and herbarium of the plants found within the radius of fifty miles from Philadelphia." At a meeting on December 22, 1891, nineteen members voted to accept the Isaac C. Martindale collection of plants representing most of the known local species. In addition to monthly meetings, the Club began to sponsor field trips to study flora in the vicinity of Philadelphia. The first of these trips was a visit to Bartram's Garden on February 14, 1892. In February, 1909, the first issue of the botanical journal **Bartonia** was published. The journal was named in honor of William P. C. Barton, Professor of Botany at the University of Pennsylvania and author of the first local flora of Philadelphia (published 1818).

From its inception the Club has been associated with the Academy of Natural Sciences where its membership meetings are held. The historical documents of the Club are deposited in the archives of the Academy. Members have contributed thousands of specimens to the herbarium of the Academy beginning with the Martindale collection, resulting in one of the most outstanding local collections in the world.

The Club now has a membership of about 260 people. Anyone with an interest in plants is encouraged to join. Monthly meetings are held on the fourth Thursday from September to May (third Thursday in November and December), at which time speakers from various fields of botany present talks. Many speakers and other members contribute articles to **Bartonia**, which is published annually. Each year numerous field trips are scheduled between April and October.

The Club is exempt from federal income tax under section 501 (c) (3) of the Internal Revenue Code and contributions to it are deductible.

As part of the Club's centennial celebration, three symposia were held: Rare Plants of Pennsylvania and Adjacent States (Morris Arboretum), Research Perspectives in the New Jersey Pinelands (Rutgers Camden), and Wetland Flora: Diversity, Function, and Importance (Stroud Water Research Center). The first two papers of this issue by Joseph Ewan and Elizabeth P. McLean were presented during 1991 at the club's January and February meetings, respectively.

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The Pause that Refreshes: 1791–1891–1991 in Philadelphia Botany and North America

JOSEPH EWAN
Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166

As we notice the founding of the Philadelphia Botanical Club we first hark back to the year of Bartram's *Travels* two hundred years ago. Linnaeus and the Linnaeans were the crowning event of the Eighteenth Century in Europe; for natural history in North America, John and William Bartram. The travels of the father and son under the patronage of Peter Collinson and John Fothergill had their apogee with the publication of William Bartram's *Travels* in 1791.[1]

By a cruel twist of fate the specimens, descriptions, and drawings from their many discoveries were given manuscript names and set aside in cabinets while the Britishers were engrossed with the plants of Cook's voyages in the exciting South Pacific. As Fothergill and his circle brought Bartram's novelties into flower, Banks and Solander were studying but not publishing on the twenty-three "firsts" from North America. Some of these plants were drawn by William Bartram.[2] European botanists revisited Bartram localities, usually after calling at the Bartram garden to learn the particulars, and then described the new genera and species under their own names. Genera now known as *Balduina, Befaria, Chapmannia, Chaptalia, Elliottia, Franklinia, Glottidium, Macranthera, Mayaca, Pinckneya,* and *Polypteris,* were all Bartram discoveries. The broadside "Catalogue" of 1783 appeared with *nomina nuda* that represented plants mentioned or briefly described later in the *Travels*.

Landmarks in North American botany published between 1783 and 1791 included Marshall's *Arbustum Americanum* (1785), Walter's *Flora Caroliniana* (1788), Aiton's *Hortus Kewensis* (1789), Lamarck's plant descriptions in the *Encyclopedie Methodique,* and L'Heritier's *Stirpes Novae,* all announcing Bartram's discoveries. It is not generally known that William Bartram's *Travels* was about press-ready in 1783. Benjamin Smith Barton, student-naturalist of the College of Philadelphia, had been listening to Bartram's vast lore, and repeatedly urged him to publish his *Travels*. From a surviving copy of Enoch Story's *Proposal to print the Travels* and from Barton's letter of August 26, 1787, from Edinburgh,[3] we know that the ambitious medical student, then 21, pressed for the publication for his own and Bartram's rewards. This Barton effort failed and it was 1790 before James and Johnson, Philadelphia printers, solicited subscriptions. Bartram's *Travels,* a fitting climax for the Eighteenth Century, remains far and away the bookmark for 1791.

Benjamin Smith Barton was a valued correspondent of the British naturalist Thomas Pennant, known for his part in the publication of the Gilbert White classic, the *Natural History of Selborne*. Pennant was prominent in the era of Joseph Banks and James Edward Smith. Pennant's membership in the American Philosophical Society was supported, even suggested by Barton. Pennant wrote of the United States: ". . . there, science of every kind begins to flourish; among others, that of natural history, in which branch I may predict, that my correspondent and friend, doctor Benjamin Smith Barton will soon rise in to celebrity, and to his pen I trust the many errors, respecting the zoology of his native country, will be corrected with tenderness and candor."[4] Letters passed between Pennant and Barton until 1796, but Barton's notes arrived too late to be incorporated in the Supplement to Pennant's *Arctic Zoology*. Barton had hoped to publish his "Elements of Zoology" as a companion to his pioneer *Elements of Botany* (1803), but subscriptions were insufficient.

When William Bartram died in his 84th year, Henry David Thoreau was a lad in Concord. Thoreau, a born naturalist, assembled a herbarium, collected zoological specimens for Agassiz at twelve, completed a course in entomology at Harvard in 1837 with Thaddeus William Harris, and read Thomas Mayo Brewer's *North American Oölogy* with a critical eye.[5] In Thoreau's library was a copy of Bartram's *Travels* and the "cosmic Yankee" made references to it on several occasions in his journals.[6] Thoreau wrote:

> "Why should we be in such a desperate haste to succeed, and in such desperate enterprises? If a man does not keep pace with his companions, perhaps it is because he hears a different drummer. . . . Let us spend one day as deliberately as Nature, and not be thrown off by every nutshell and mosquito's wing that falls on the rails. . . . Time is but a stream I go a-fishing in. I drink at it; but while I drink, I see the sandy bottom and detect how shallow it is. Its thin current slides away, but eternity remains."[7]

David Starr Jordan wrote "it has been said reproachfully of Thoreau that with a genius which might have directed great enterprises, he preferred instead to lead a huckleberry party. . . . I have always sympathized with Thoreau." Jordan added: "it is easier to find leaders in the battles of the world than pioneers in the field of science."[8]

In 1891 the Philadelphia Botanical Club had two fortunes: its leading figure was a field botanist, and it had an institution, the Academy of Natural Sciences, with an herbarium and library resources to provide encouragement. The field botanist, Jeremiah Bernard Brinton,[9] was a native of Chester County, son of a Quaker farm family, a Jefferson Medical College graduate, M.D., 1859, who was elected a member of the Academy of Natural Sciences in 1878. Dr. Brinton's botanical interest went back to his materia medica course and the story of his identifying a wayside flower while serving on the battlefield of the Civil War. We can mark a red-letter day for Brinton. Since the Bartram years the New Jersey Pine Barrens had been a mecca for naturalists because of its singular plant associations. When the American Association for the Advancement of Science convened in Philadelphia in 1884, it was natural that an excursion to the Pine Barrens would be planned for the visitors. Brinton was an excursion guide! Two illustrious botanists were in the party: Asa Gray, then 74, and the Keeper of Botany at the British Museum of Natural History, William Carruthers.[10] Carruthers had just attended the British Association meetings in Montreal. Surely one of the Pine-Barren exhibits featured was the Curly-grass fern, *Schizaea pusilla,* collected at Quaker Bridge near the first of the century and described by Frederick Pursh, who had been employed by Professor Barton.

The Botanical Section of the Academy was especially active in the 1880s, and collections were arriving from around the world. Brinton saw a complementary need for a local flora field oriented "eminently clubbable" group, and so the Philadelphia Botanical Club was founded December 1, 1891. Eight men met in the Council Room of the Academy with the object of preparing a checklist of the flora within a fifty-mile radius of Philadelphia, to be documented by herbarium specimens.[11] Of the eight members four are particularly remembered today: Thomas Meehan,[12] English-born botanist, horticulturist, editor, who came to Philadelphia from Kew in 1848, and was elected to the Academy in 1860. We should appreciate Meehan for his efforts on behalf of the

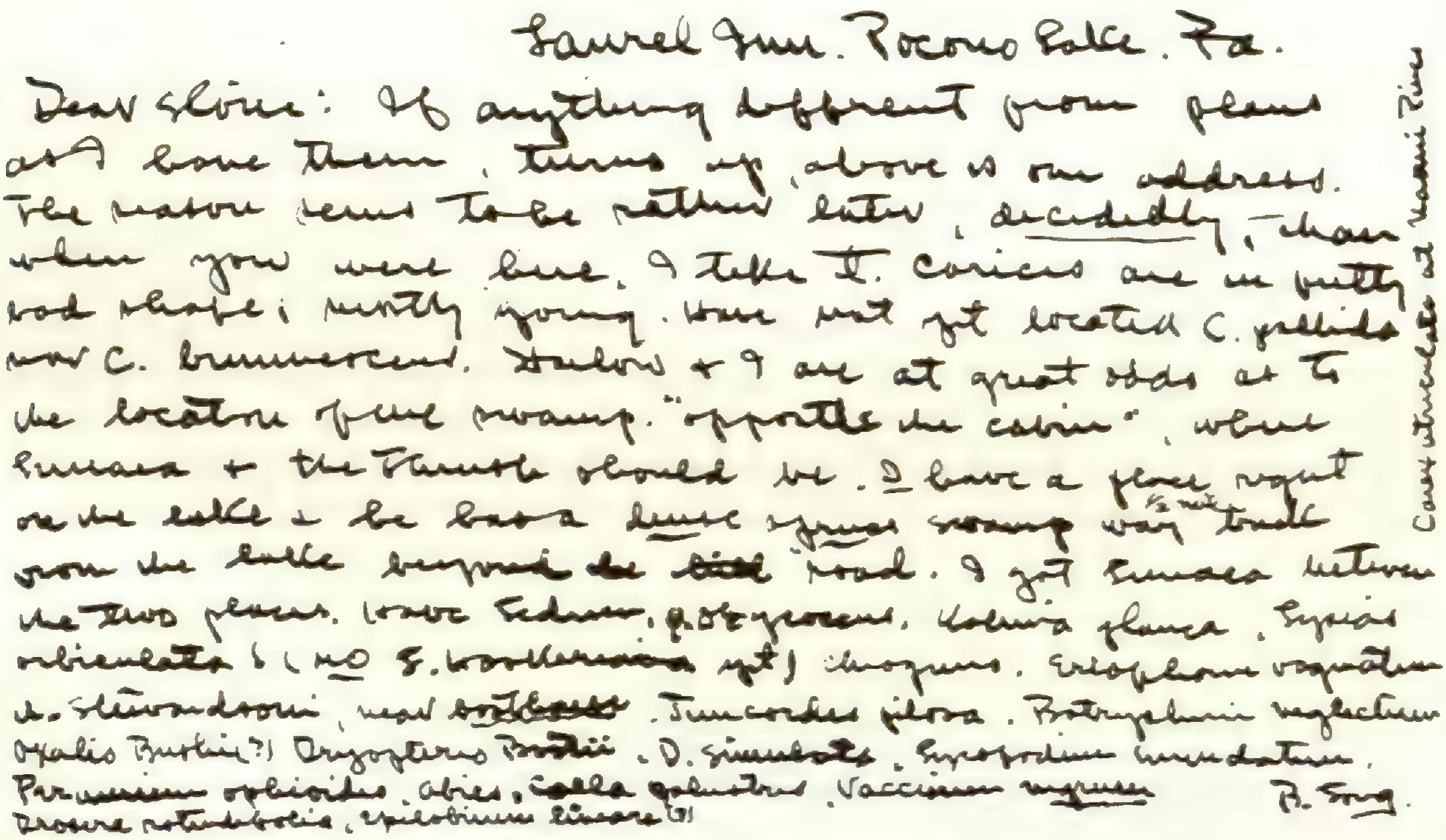
Bartram garden when its fate hung in the balance in the 1890's. Isaac Martindale[13] of Camden collected ballast plants, a kind of botanical game in those years, and assembled an important herbarium, now at the National Arboretum. Naturalist Witmer Stone,[14] author of the classic on the Pine Barrens, so prized as to be reprinted, wintered at the Academy and summered at Cape May where he enjoyed birding. A fourth member of the founding coterie was Stewardson Brown,[15] botanist and ornithologist. He was in charge of the Academy's herbarium from 1900 until to his death in 1921, served as first editor of *Bartonia*, and co-authored the *Alpine Flora of the Canadian Rocky Mountains*, published in 1907. His brother Amos Brown held the chair of geology at the University of Pennsylvania. Stewardson kept migration records of birds at Germantown for the USDA and made a collection of bird skins. He botanized from British Columbia to Jamaica and Venezuela.

Outside the group of eight founders were two Philadelphia botanists active at the Academy: Joseph Trimble Rothrock[16] of West Chester, and John Howard Redfield,[17] who came from Connecticut. Both had been in Asa Gray's botany classes. Rothrock knew the West from Alaska to southern California. He taught botany at the University of Pennsylvania. Redfield transformed the Academy's "neglected botanical collections," in Pennell's words, "into an efficient herbarium." He was 76 the year the Club was founded and was promptly elected an honorary member. Redfield's dedication to botany at the Academy was shown by his will to sell his collection and invest the monies in the purchase of exsiccatae then coming on the market. Accordingly, his herbarium was sold to the Missouri Botanical Garden during the capstone years of William Trelease's directorship. Redfield's "valuable scientific library" of over 280 titles was auctioned in Philadelphia in December 1895. From the printed auction catalogue we see Cornut's *Canadensium plantarum* of 1635 described as "the rarest and first work on American botany" sold for $20, four of Plukenet's *Opera* netted $2.60, and Rafinesque's *Medical Flora*, 2 volumes, uncut, in boards, sold for $4.60! I should like to know what became of Redfield's copy of Darlington's *Memorials of John Bartram* . . . (1849) with thirteen photographs of Bartram and Marshall items laid in?

Professor John W. Harshberger,[18] though not a founding member, soon joined the Club. Associated with University of Pennsylvania Botany Department from his doctorate in 1893, Harshberger's interests included history of maize, ethnobotany—he first used the word in an article in the *Botanical Gazette* in 1896—and plant geography. His "Phytogeographic Survey of North America" amounting to 853 pages was volume 13 in Adolf Engler's *Die Vegetation der Erde* (1911). Harshberger's Survey prompted Professor Fernald to warn that "any conclusions which may be innocently based by the unwary upon this 'Survey' will always be open to doubt."[19] Harshberger's "most permanent work" in Pennell's opinion was his history entitled *Botanists of Philadelphia and their work* (1899), "a mine of originally obtained information."[20] Of the 320 publications listed by Harshberger in his rather curious "autobiography"[21] privately published in 1928, the year before his death, none appeared in *Bartonia*.

John Muirhead Macfarlane[22] arrived in Philadelphia in the summer of 1891 filled with memories of the Edinburgh Botanic Garden. He was associated with the Department of Botany at the University of Pennsylvania for twenty-seven years. In 1892, without delay, he established the University's Botanic Garden. Six years after the Club was founded Professor Macfarlane launched the Botanical Society of Pennsylvania. It is said soon to have had 150 members but the Society waned after 1943.[23] Macfarlane had wide interests: *Causes and Course of Organic Evolution, a study in Bioenergics* (1918), *Evolution and Distribution of Flowering Plants. Volume One: the Apocynaceae and Asclepiadaceae* (1933) and the *Evolution and Distribution of Fishes,* (1923), but his best known work was on carnivorous plants, contributing to Adolf Engler's *Pflanzenreich.* Withal Macfarlane's interests were not with the Club.

In contrast Bayard Long[24] who joined the Club at twenty-one, curated the local herbarium from 1913, is remembered as the most active field-botanist in the Philadelphia area. Devoted, quiet, Bayard was a reporter-general on what was unrecorded, where it had been found, and the total biology of the plant. Since he washed the specimen before carefully spreading the plant in the press, he knew facts often passed over. Fernald appreciated Bayard's acumen and care, tramped with him on forays from the St. Lawrence to the James, and chronicled their trips in the pages of *Rhodora.* The Academy's archives hold six letters written by Bayard Long to Witmer Stone from Pocono Lake and Orono, Maine. With the thrill of discovery he writes of finding *Arethusa* at Tuckerton, and hopes that Witmer is having "good luck" at York Furnace. On sixteen close lines of a postcard Bayard reported from Laurel Inn, Pocono Lake, that he had not "located Carex pallida brunnescens," but he had named 24 collections. So much for a one-cent McKinley postcard!. He wrote Witmer Stone on August 3rd, 1916, "are you vacationing at Cape May?" and that Fernald computed the other day about three hundred good range extensions and twelve or fifteen species new to [Maine]." He quizzed Witmer, "do you have Habenaria integra?" On August 22nd he wrote, "Congratulations on Habenaria integra! . . . You will be interested that [K. K.] Mackenzie went after it sometime during the end of the last week of August and reports 'no luck at all' But as for mosquitos maybe Witmer Stone got here first! no?" In an undated letter from Spray Beach, Beach Haven, New Jersey, evidently in 1913, Bayard wrote that "my family is persuading me to stay down here continuously—having a regular loaf and vacation—so I would join the Phytogeographical Excursion from this



Laurel Inn. Pocono Lake. Pa.

Dear Stone: If anything different from plans at home there, turns up, above is our address. The season seems to be rather later, decidedly, than when you were here. I take it. Carices are in pretty good shape; mostly young. Have not yet located C. pallida nor C. brunnescens. Harlow & I are at great odds as to the location of the swamp "opposite the cabin", where [illegible] & the [illegible] should be. I have a place right on the lake & the back a dense spruce swamp way ½ mile back from the lake beyond the ~~[illegible]~~ road. I got [illegible] between the two places. [illegible], [illegible], Kalmia glauca, [illegible] orbiculata & (no S. [illegible] yet) [illegible]. Eriophorum vaginatum & [illegible], near [illegible]. Juncoides pilosa. Botrychium neglectum Oxalis Brittoni(?) Dryopteris Boottii. D. simulata. Lycopodium inundatum. [illegible] ophioides. Abies. Calla palustris. Vaccinium [illegible] B. Long.
Drosera rotundifolia, Epilobium lineare(?)

Carex [illegible]

FIG. 1. Information on McKinley postcard from Bayard Long to Witmer Stone. Library Archives, Academy of Natural Sciences.

end." He footnoted the train times: "leave Philadelphia 9:08 AM, arrive Barnegat 10:53. I suppose?" Bayard Long's biographer, Jack Fogg, reported that the Club member of more than forty years, collected in excess of 80,000 numbers! Bayard's father John Luther Long, created what became "Madame Butterfly" from a *Century Magazine* story in 1898. Bayard, unsalaried by the Academy, benefited from the profits. After a bout of scarlet fever Bayard wrote Witmer, "I'm counting on having a simply gorgeous spring of botanizing."

In the year of the Club's founding what was happening around the country? A moving influence for popular support of botany and horticulture was the founding of the New York Botanical Garden in Bronx Park.[25] Beside the evangelical mission of the Audubon Society and its journal *Bird-Lore*, the Garden was a seedbed of the environmental movement. The Torrey Botanical Club promoted the Garden's establishment two years before reality. Judge Addison Brown,[26] an enthusiast for botany but never a professional, effected the legislation to create the Garden. The judge worked closely behind the scene with Nathaniel Lord Britton,[27] thirty years his junior. Five years after the Garden was established botanist Britton and Judge Brown published the *Illustrated Flora of the Northern United States*. It would be the greatest stimulus to serious naming of the native plants up to its appearance. The three volumes featured over four thousand line drawings, the funding by Addison Brown. He is reputed to have read proof for the *Flora* during his final illness.

But Lloyd Shinners, a catalytic and sometimes discordant botanist, acute field explorer and herbarium zealot, disagreed on the taxonomic value of the editions of the Britton and Brown *Flora*. Shinners wrote, "they represent the most backward steps ever taken in American botany."[28] He insisted Britton's "real contribution" was the creation of the rich library and herbarium resources, and suggested that the popular commercial success of the Flora perhaps made possible the Garden's favorable public estimate. The crux of the hostility of Shinners to Britton and his *Flora* was the role it played in the controversy in botanical circles on the adoption of strict priority in the publication of valid plant names. This practice favored by Britton and the so-called "American Code" displaced familiar botanical names on many occasions. Schisms divided botanical organizations beyond the public's use of identification manuals.

Lloyd Shinners did not consider the advantageous model that the Britton and Brown *Flora* played in the writing and success of its West Coast counterpart, the admirable *Flora of the Pacific Coast*. That illustrated *Flora* imitated the eastern model in several ways including the line drawings for each species. It was carried out by Britton's admirer, LeRoy Abrams[29] of Stanford, the genial professor of botany who succeeded William Russel Dudley.

This controversy over the rules of nomenclature to be followed was felt at the Academy, and, by extension, to some extent among members of the Philadelphia Botanical Club, though there was wider support at the time for what was known as the "Kew Rule."[30] This favored the use of well known though not necessarily the earliest published binomial in use since the years of Asa Gray. Club members confronted the strict priority issue when they used Britton's *Catalogue of Plants Found in New Jersey*[31] which was opposed to the Kew Rule. Yet Britton's *Catalogue* which cited stations for plants and named the collectors, prodded Philadelphia field botanists to search for overlooked Pine Barren records.

Another 1891 event of historic importance for botany in America was the publication of volume one of Charles Sprague Sargent's *Silva*.[32] It would stand eventually as fourteen quarto tomes. With its Ehretian plates by Faxon, full descriptions of North American woody plants with plant-hair precision, folk names, and, for me, rich historical asides, the *Silva* was a Nineteenth Century triumph, in dendrological literature America's finest hour.

Also in this 1891 garden of events was the founding of Stanford University. When President David Starr Jordan enlisted the Stanford faculty he said that his search was "in general . . . rigidly compelled by limitation of funds to look for men of future promise rather than of actual professional achievements." To direct the botany department was Douglas Houghton Campbell, "a brilliant young investigator . . . lately returned from Europe."[33] President Jordan did not have to wait long for results: Campbell's text on the morphology of mosses and ferns appeared in 1895 followed by later editions, to remain in print for thirty five years!

Where Campbell scrutinized the cryptogams; William Russel Dudley,[34] first studied the marine phanerogam, *Phyllospadix,* and then the tallest tree on the North American continent. Dudley had collected plants for Jordan's botany laboratory when Jordan was a Cornell instructor, and so it was natural that Dudley be plucked for professor of systematic botany by Stanford's president. Dudley, "a born teacher" in LeRoy Abrams' estimate, was instrumental in preserving the first public redwood park, the "Big Basin" of Santa Cruz. We recall that last year Yosemite National Park celebrated its centenary, and so the 1890's gave impetus to the environmental movement, fostered popular plant lore in field and garden, and gave us lasting groves of knowledge with Sargent's *Silva*.

Born on a farm near Wawa, Delaware County, Francis Whittier Pennell[35] travelled and botanized in the Americas, south to Chile. Before coming to the Academy in 1914 he was on the staff at the New York Botanical Garden where Donald Culross Peattie "encountered a young man, gentle and deliberate." He was in charge of the Academy's herbarium until his death in 1952. He served as the Club's president for ten years, edited *Bartonia* from 1924, contributing essays on, for example, serpentine plants, and botanical history. He posed the question in 1943: "in scanning the record of such prolonged activity in the collecting and study of the flora of our Local Territory, one wonders whether we are near the conclusion of this effort to identify and classify its component parts and to portray their distribution, or whether we are still relatively near the beginning." Pennell went on to say that we are indeed moving toward completion, but that why plants occupy their niches in the biome—dictates of soil, pollination, dispersal and past migration of floras—"there remains for generations to come fascinating work for the membership of the Philadelphia Botanical Club." Dr. Pennell's contribution to the Academy and the Club, his close friendships with Conway Zirkle, Henry Pilsbry, James Rehn—virtually the entire Academy fellowship—and his efforts on behalf of the library, his aiding and abetting the works of botanists here and abroad,—made him a treasure among botanists.

What may be the mission today, if not the reason for existence, of botanical organizations such as the Philadelphia Botanical Club into the next hundred years? Will the narrow endemics of restricted habitats soon be known only, if at all, in botanic gardens? It was only a few years ago that saving the disappearing Kate Furbish's Lousewort, *Pedicularis furbishiae,* named by Sereno Watson in 1882, was a national issue. Two weeks ago I glimpsed from the train window a still surviving colony of fan palms, *Sabal minor,* on the western shore of Lake Pontchartrain northwest of New Orleans. I used to take my taxonomy classes to see the palms growing on a relic island of vegetation of the Pleistocene delta, where it was associated with Pumpkin ash, *Fraxinus profunda,* because there the palm was not the usual nearly stemless "Dwarf palmetto" but stood eight to ten feet tall. That growth form is a puzzling variant that led L. H. Bailey to visit the site and to photograph the tree-form.[36] When New Orleans ingests more of its surrounding wetlands we will lose one more fascinating instance of palm biology yet to be understood.

The decisive role of botanical organizations around the world in saving environments whether it be outskirts of New Orleans, Philadelphia, or Cape May, is very real. The formula is not too complex to understand: to know an organism well enough to call its name, which is one critical role of the field trips of your Club, is a good beginning. To know is to care, even to love, and there follows a better chance, protection may follow.

ACKNOWLEDGMENTS

For forty years—from 1950 when Francis Whittier Pennell and his associates encouraged the use of its resources—it has been our cherished privilege to know and admire many of those who have worked in this treasury of American natural history, that is the Academy of Natural Sciences of Philadelphia. Once again Carol Spawn and Karen Stevens have made available the resources of the Academy's archives.

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Bartonia No. 57: 10–27, 1992

John and William Bartram: Their Importance to Botany and Horticulture

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The Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103-1195

John and William Bartram were two extraordinary individuals, yet their characters are often stereotyped. John is presented as a simple farmer, self-taught in botany, who discovered the *Franklinia* before it became extinct. His son William is romanticized as a dreamy explorer, whose writings influenced Coleridge and Wordsworth. These concepts are true, but only as part of a much larger whole. Both Bartrams made important contributions to botany and horticulture; these contributions would have been even greater had they been fully appreciated in their own time.

John Bartram (1699–1777) was born in Darby, part of the countryside to the southwest of Philadelphia, the son of Quakers who had emigrated from Derbyshire in England. His schooling was through fifth grade at the Darby Friends. In 1728 Bartram purchased a farm of 112 acres on the banks of the Schuylkill, below Gray's Ferry; he was a good farmer—his yield of wheat was twenty-eight to thirty-six bushels an acre, compared to the average of ten or less at the time.[1] Bartram ameliorated his soil with fertilizer and red clover, indicating that he was in touch with the more advanced farming practises of the period.[2] His understanding of the soil and his ability to grow plants well were essential to Bartram's future role in botanical and horticultural history. Most important, however, were his inquiring mind and discerning eye. The scrutinizing mind was certainly a factor in Bartram's being read out of meeting for questioning the divinity of Christ, although he considered himself a Quaker all his life—and continued to attend meeting.[3]

The fact that John Bartram was a Quaker was important both for his education and for the network into which he fitted. The romantic story is that Bartram was suddenly converted to an interest in nature by the contemplation of a daisy.[4] His son William, however, wrote that "He seemed to have been designed for the study and contemplation of nature, and the culture of philosophy . . ." implying that it was part of his Quaker background.[5] The Quakers appreciated Nature well before their contemporaries, seeing it in part as an expression of God's handiwork.[6] The Quakers very early developed a supportive network between Pennsylvania and England which, interwoven with religious, political, and business connections, fostered mutual botanical and horticultural interests. This connection formed the early base of Bartram's contact with England.

Bartram may seem an unlikely candidate for the man of the hour for an England badly deforested, due to centuries of overcutting for fuel, the infant iron industry and timber for his majesty's ships.[7] This temperate island, warmed by the Gulf stream, where seemingly anything will grow, has been actually poor in native flora since the ice age; the only native evergreens are holly, pine, yew, and perhaps box. At the time of a physical need for trees, there was also an aesthetic demand. The 18th century was the time of the development of the classic English landscape, of William Kent and Capability Brown. Influenced by a vision of the imagined Roman landscape, English gentry were tearing out their formal gardens and replacing them with sweeping lawns, groves of trees and where possible, still water. For this they needed quantities of trees, and looked overseas for their supply.

The 1730s, when Bartram was beginning his farming, were a time of scientific inquiry in England. The Royal Society had been formed in 1662 and was very active; gentlemen made collections of natural science for their cabinets. It was a seminal time for botany. In the 17th century, both the Chelsea Physic Garden and Oxford Botanic Garden had been formed for the holding and study of plants. In the early 18th Century: a German, Dillenius worked at Oxford; in Leyden, Gronovius studied John Clayton's plants from British North America; Linnaeus was publishing his *Systema Naturae*.[8] Botany became a connector between landscape and science.

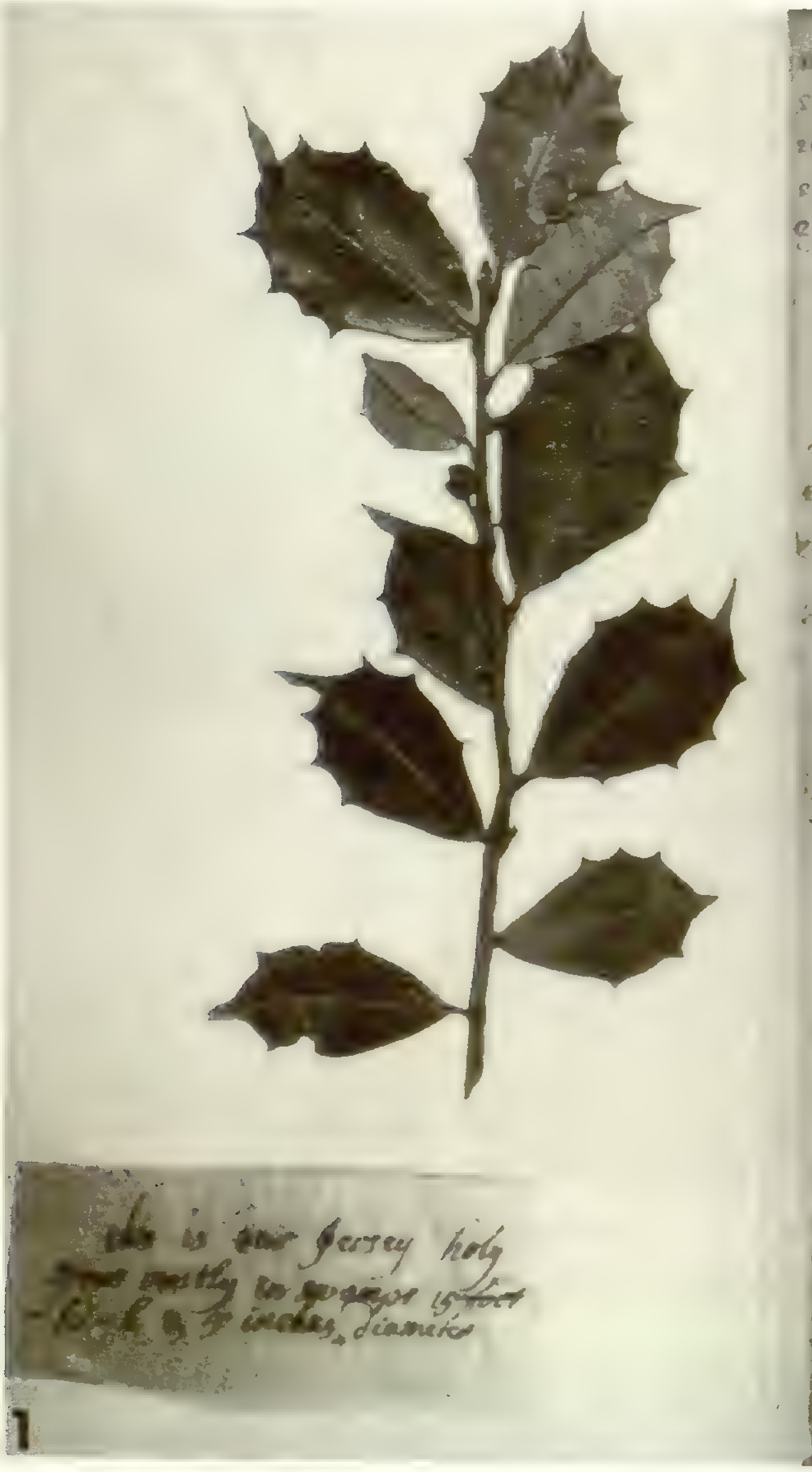
Peter Collinson (1694–1768) was "The Great Connector" between botanists, landed gentry planting trees on their estates on one side of the Atlantic, and John and (ultimately William) Bartram on the other. A fellow Quaker, a draper by trade, and a passionate gardener, Collinson had only an elementary education, and was wholly self-taught in botany. Nevertheless, he became a Fellow of the Royal Society in 1728. Collinson had helped Mark Catesby publish his *Natural History of the Carolinas*, by finding him patrons.[9] Collinson's friendships cut across the stereotype of rigid British class lines; for example he was a friend of Sir Hans Sloane, the greatest patron of early 18th century botany. It was Collinson who arranged Sloane's Natural History specimens, after his death, at the new British Museum in Bloomsbury.[10]

Collinson's firm dealt with the colonies, and he used these connections to importune for seeds and plants. One can imagine that some of his less enthusiastic trans-Atlantic friends wearied of this, and one of them, presumably the Philadelphia Quaker merchant Joseph Breintnall, suggested John Bartram as a likelier source. The relationship between Collinson and Bartram, beginning in 1733, was to develop and flourish until Collinson's death thirty-four years later. What Peter Collinson was looking for was simply a collector, who would send back seeds and plants: to go to the estates of the landed, to go into his own garden, and to go to botanists of the time for study and identification. In John Bartram, what he got was: an inquiring mind, discerning eye, a thirst for knowledge, a superb field botanist and naturalist, all within a man of staunch upright character.

By 1737, Bartram had Parkinson's *Theatrum Botanicum* and Philip Miller's *Dictionary,* and asked for Tournefort's "Herbal."[11] Collinson replied that "I would not have the puzle thy Self with Others . . . remember Solomons' advice that in the reading of books there is no end."[12] Bartram replied: "I take thy advice about books very kindly, although I love reading dearly. . . . i believe if Solomon had loved women less & books more, he would have been a wiser & happier man;" Bartram got his books.[13] His books, which were to include Tournefort, Catesby, Gronovius, Dillenius, Miller, Linnaeus, Hill, and Sloane, put Bartram in touch with the international botanical community.[14] In particular Miller's *Dictionary,* in various editions, became the common botanical language; Jefferson had it, Washington had it, even Franklin, that most urbane of urbanites, had a copy.

The travels of John Bartram will only be summarized here as they are fully treated elsewhere.[15] Quite promptly, Collinson found Bartram his first patron: Robert James, the 8th Baron Petre. This brilliant young Catholic Lord, a member of the Royal Society, was interested in quantities of uncommon trees for his Essex estate, Thorndon.[16] Bartram's first assignment, in 1735, was to follow the Schuylkill to its source; the following year he explored "the Jersies." Collinson instructed Bartram in methods of plant collecting and sending plant specimens; some of the latter also went to Lord Petre for his herbarium (FIG. 1). The seeds were to be sent in a box 18″ deep, two feet square, the seed packed in dry sand, the box to be placed in the captain's cabin—and covered with lathe to protect it from the ship's cat. Bartram was to be paid 5 guineas a box.

In 1738 Collinson and Lord Petre underwrote a trip of 1100 miles through Delaware, Maryland, and Virginia to Williamsburg. Collinson then gave Bartram detailed instructions, such as keeping a journal, and putting live plants in an ox bladder tied to his saddle bags. Equally important, Collinson supplied introductions, thereby pulling Bartram into Collinson's American network. Bartram's hosts included some of the elite of the American horticultural world. John Custis of Williamsburg had one of the great gardens of the period, full of exotic plants—many of which had been supplied by Peter Collinson. Bartram admired the greenhouse and library of William Byrd of Westover; he called on John Clayton (for whom *Claytonia* is named), but he was away; he also met William and Isham Randolph. After exploring the James River, Bartram made his way back across Blue Ridge and up the Shenandoah Valley.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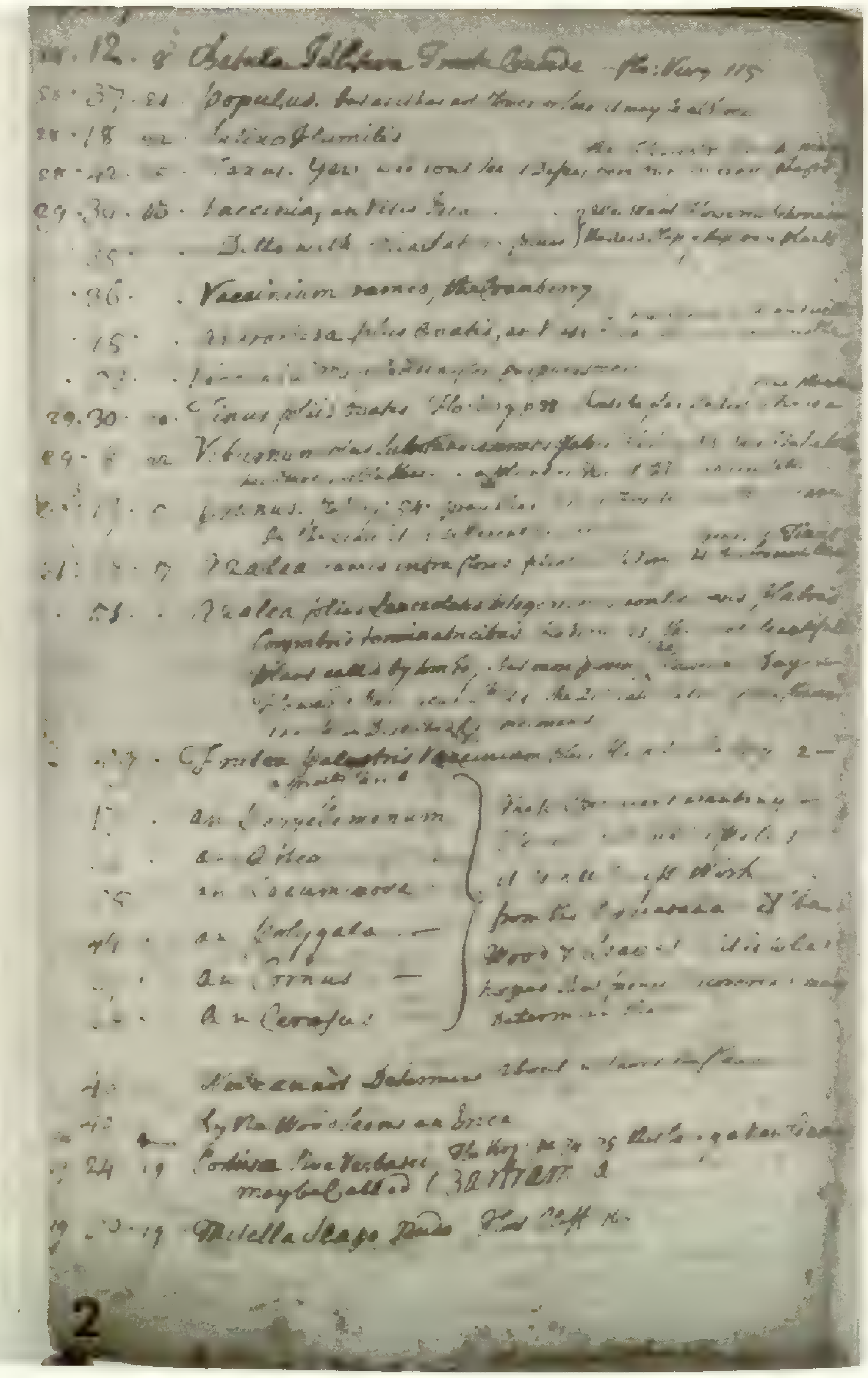
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FIG. 1. John Bartram's specimen of *Ilex opaca* Ait., now in the Petre Herbarium at the Sutro Library. FIG. 2. Collinson's list of Bartram specimens as identified by Gronovius (courtesy of Historical Society of Pennsylvania).

For the next 20 years. Bartram's collecting was intensively local: Pennsylvania, "the Jersies," and a number of excursions to New England and Upper New York. One of the latter was his 1743 journey to the headquarters of the Five Indian Nations at Oswego, New York with Conrad Weiser and Lewis Evans. Collinson published Bartram's account of this trip, without the latter's knowledge.[17] The book was full of printing errors, perhaps due to the unfamiliarity with Bartram's hand and the plant names. The public may well have thought the errors were due to Bartram's lack of "literal education," which rendered his "style . . . not so clear as we could wish," as the publisher's patronizing preface put it.[18]

On other New York trips Bartram visited Dr. Cadwallader Colden of Coldenham, New York, a correspondent of Linnaeus. In 1753, Bartram took his son William, then 14; they then saw the drawings of Colden's daughter, Jane a student of the Linnaean system. One feels that this visit influenced William, who must have taken one look at Jane's drawings (best described as "interesting") and thought "I can do better than that"—and he could!

In 1761 Bartram went west to Pittsburgh and the Ohio River, bringing back the first pecans. By this time Collinson had procured over 100 clients—though they did not subscribe all at the same time—enabling Bartram to spend more time collecting, although always his trips were built around the harvest season.[19]

It is with his expeditions to the deep south that Bartram is particularly identified; the first of these was in 1760 when, at the age of 60, Bartram went to the Carolinas. On his expedition to Charleston he met two nursery-people, Thomas Lamboll and Martha Logan, with whom he later corresponded. He spent time with Dr. Alexander Garden (for whom *Gardenia* is named) who was sending plants and seeds to Peter Collinson, and was also a correspondent of Linnaeus. In 1762 Bartram returned to North Carolina and Virginia. He wanted to return again and explore Florida and Georgia: "The variety of plants & flowers in our southwestern continent [which to Bartram included Florida] is beyond expression. Is it not, dear Peter the very palace garden of old Madam Flora?"[20]

Then came the high recognition: in 1765, through Peter Collinson's efforts, John Bartram was made Botanist to the King at £50 a year, with instructions to botanize "East Florida." In July of the same year, at the age of 66, John Bartram embarked with his son William on his last great expedition. They stopped in Charleston and botanized through Georgia; on the banks of the Altamaha River at Fort Barrington, they discovered *Franklinia alatamaha* (it not then blooming, but Bartram's sharp eye recognized it as something new). From Florida Bartram brought back specimens but not seeds of the *Illicium floridanum*.

Three years later, Bartram's great friend and supporter, Peter Collinson died. Dr. John Fothergill took over some of the importing arrangements on a much smaller scale, but no other correspondent replaced Peter Collinson's friendship.

The description of Bartram's travels gives one some idea not only of the range of his plants explorations, but also of his botanical circle in America—and not all have been mentioned. These included: Jared Elliott in New England; Cadwallader Colden in New York; Benjamin Franklin and James Logan of Philadelphia (the latter a mentor); John Clayton, John Custis, and William Byrd of Virginia; Dr. John of Virginia and England (who arranged for Bartram to send plants to Kew) and Dr. Alexander Garden of Charleston. This was the American botanical network, and Bartram was at the heart of it . . . but it was not to fellow Americans, by and large, that Bartram was supplying plants. The American botanical community was interwoven with the European, particularly the English . . . and Peter Collinson was the connecting link.

John Bartram's significance to the European botanical and horticultural community was more than he has been given credit for. His contributions to horticulture and sylviculture are perhaps best known. Bartram was not the only American supplying seeds and plants to England, but no one could compete in sheer numbers. One of Bartram's first orders to Lord Petre in 1735 included: "3,000 black walnuts, a peck and ¾ dogwood berries, 2 pecks red cedar berries, 3200 swamp spanish acorns."[21] By 1741 Collinson could report: "The trees & shrubs raised from thy first seeds are grown to great maturity. Last year Lord Petre planted out about 10,000 American, which being at the same time mixed with about 20,000 Europeans and some Asians, make a very beautiful appearance. . . ."[22] Bartram's clients included the Dukes of Bedford, Richmond, and Argyll; the latter planted out 100,000 trees annually. The dukes and lords may have set the tone, but Bartram's nurserymen clients were equally important, for they supplied lesser folk. James Gordon, who could propagate anything, had been gardener to Lord Petre; Christopher Gray specialized in American plants. Bartram's plants thus made their way through a wide circle in England.

It was not merely the sheer numbers of the introductions, but their quality which were significant. Through Peter Collinson, Bartram was introducing new plants to both science and horticulture. American plants appeared slowly into England before 1700; the number has been given as one hundred and fifty, which doubled by the time Bartram started his collecting. According to Barnhart, "about three hundred and twenty plants were introduced" during the forty years of Bartram's collecting.[23] Although Peter Collinson is credited with forty of these, Philip Miller is credited with two hundred.[24] Bartram's introductions included: flowers such as beebalm, *Monarda didyma,* shrubs such as *Rhododendron maximum,* and trees such as *Acer pensylvanicum* and *Magnolia acuminata.* Bartram also reintroduced some treasures which were in and out British gardens in the 17th Century, such as the shooting star, *Dodecatheon meadii,* which Catesby illustrated from a plant in Peter Collinson's garden.

These plants formed the beginning of a new style of garden: the "American Garden." One of the earliest was that of Dr. John Fothergill, who wrote Humphry Marshall in 1772, "Under a north wall, I have a good border, made up of that kind of rich black turf-like soil, mixed with some sand, in which I find most part of the American plants thrive best . . . it is acknowledged by the ablest botanists we have, that there is not a richer bit of ground, in curious American plants, in Great Britain."[25]

Bartram's influence on the botanical community is more complex. The garden itself was a mecca. Everyone visited: Alexander Garden, Dr. John Mitchell, and Peter Kalm, the pupil of Linnaeus, who called on Bartram three days after his arrival in Philadelphia in 1748. Kalm paid frequent visits thereafter and requested seeds be sent to Linnaeus, examined plants in Bartram's herbarium, and had lengthy discussions. Kalm wrote that "We owe to [Bartram] the knowledge of many scarce plants, which he first found, and which were never known before. He has shewn great judgment, and an attention which lets nothing escape unnoticed. Yet with all these great qualities, he is to be blamed for his negligence, for he did not care to write down his numerous and useful observations."[26] Kalm who "owe[d] him many things," then quoted Bartram throughout his *Travels.*

Bartram's specimens were a valuable source of information for the European botanical community, one which seems to have been underutilized. Bartram followed Collinson's instructions; each specimen was to be numbered, with Bartram keeping a matching numbered specimen. Collinson would then have the specimens identified by Gronovius at first, then Dillenius, and lastly Solander. Collinson would then return a numbered list to Bartram, sometimes commenting "a new species, we know it not" (FIG. 2). In one case, Bartram sent specimens specifically to Mark Catesby, who had failed to draw the paw paw (*Asimina triloba*) on his sojourn in the Carolinas; fruit and flower were pickled in rum.

Other specimens went to Linnaeus, Solander, Lord Petre, Sherard, and Sir Hans Sloane. Bartram's Ginseng (*Panax quinquefolius*) specimen is now in the herbarium of the British Museum of Natural History (FIG. 3). There is nothing on the sheet from Gronovius's herbarium which indicates that the specimen is Bartram's except the description: "This Ginzeng I found up Delaware, the latter end of August . . . this groweth on the northeast sides of a mountain by the river sides where the sun seldom shines." and the knowledge that Clayton never botanized the Delaware. Bartram had written to Collinson when in 1739, he went "into Jersey . . . ye northeast side of a very steep shady hill which . . . was 40 pearch high perpendicular from ye river . . . in this dark shady place ye ginseng growed."[27]

Bartram's descriptions on his specimens were fairly minimal. "Jersy holly," (*Ilex opaca*) was described on Lord Petre's specimen as "our jersy holy grows mostly in swamps 15 foot high & 5 inches diameter."[28] It was in Bartram's letters that he passed on fuller information, such as the information about the collection site of the ginseng. In 1753, Bartram sent Collinson detailed descriptions of native trees, the conditions in which they grow best, and their uses (including Indian uses.) It would have been useful

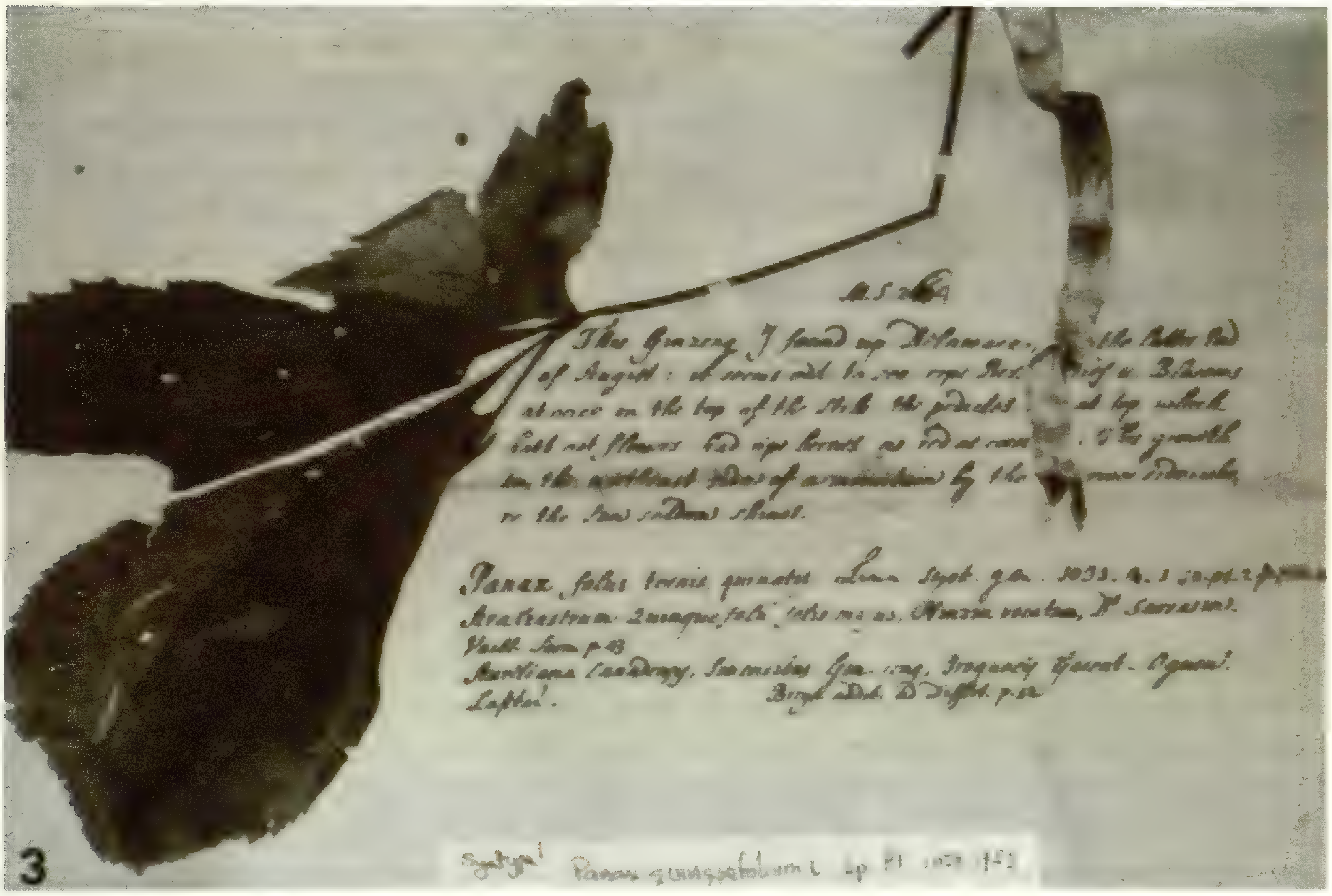


FIG. 3. John Bartram's specimen of *Panax quinquefolius* L. from Gronovius's herbarium.

for sylviculture of American species, had Collinson passed this information on, but there is no evidence that he did. Of the Sour Gum (*Nyssa sylvatica*), Bartram wrote:

> nissa grows from New England to florida generaly in moist low ground or swamps but will grow in dry poor gravely hilly ground in all expositions to a large regular tree 3 or 4 foot diameter and 100 foot high y^e bark is rough in large trees with perpendicular clefts and some horizontal fissures y^e tree is male & female distinct from a pointed bud is produced a spring shoot set with leaves allternately round out of y^e bosom of y^e 3 or 4 leaves near y^e base proceeds slender peduncles one inch & a half long more or less each producing from one to 3 or 4 roundish or oval fruits of a blewish color containing a striated or oblong or flatish stone this tree is remarkable for its admirable variety or y^e colors of its leaves gradualy changing as y^e Juices is maturated & condenced; in y^e end of June or y^e beginning of July many of y^e lower leaves of y^e shoot begins to turn spoted first yellow mixed with y^e green shineing leaf then flesh color prevails over y^e whole then a fine shineing crimson when thay often drop but if thay stil on y^e tree many dark spots apears which soon spread over y^e whole leaf then it soon drops so that for two months or more this tree is adorned with y^e glorious colors in y^e several degrees of new shineing green yelowish striped spoted below flesh color crimson dark red & allmost black on y^e same tree. . . .[29]

Before 1742, Bartram had also sent a specimen of the *Nyssa sylvatica* to Collinson for Lord Petre.[30] It was not be described until 1785 by Humphry Marshall.[31] (Linnaeus had lumped all the *Nyssa* under *N. aquatica*.[32])

Collinson's response to Bartram's small treatise was patronizing.[33] "Thy descriptions are so exact and natural, that I am always delighted with reading them; but, my good friend, I must import to thee my doubts. I am afraid the species are so multiplied, that it will be a difficult task to distinguish them here. Collinson then commented that the differences must be "purely owing to their situation"—[especially as] in England we have but two species of oak."[34] Certainly Bartram's punctuation leaves much to be desired, and his descriptions of ten oak species are not as precise as one might wish. Given the poverty of genera in England, it was difficult for Collinson to accept the number of new species in Eastern North America, and so some of Bartram's went unnoticed.[35]

Bartram also sent descriptions to Philip Miller, who asked him to condense them (according to Bartram, Miller was only interested in leaves and acorns). Bartram was unrepentant: "I can often discover our diferent species of oaks one from another by thair form of growth half or a whole mile distance & I am sure he must be very sharp sighted that can know them at half that distance by thair leaves acrons or cups all together."[36] Bartram was a field botanist, and was critical of those who identified plants only from specimens, writing Collinson that John Hill was "very far from being exact . . . there is a great many omissions and errors I suppose for want to opertunity to examine y^e subjects himself."[37]

By 1765, Bartram's descriptions have become more precise, as his diary of his 1765 expedition shows. The water-shield, *Brasenia Schreberi*[38] is described as:

> A very odd species of this genus [Colocasia] which I take to be perenial. but I could not find any in its natural places of growth[.] what I saw was drove by storms on or near y^e shore[,] broke off from its root.] y^e stalk is so scarsely so thick as A wheat straw. very red & near y^e surface of y^e water sends forth y^e pedicles of y^e leaves 4 to 6 inches long[,] which enters y^e center of an oval leafe very red on y^e under side and 4 inches y^e longest way & 3 y^e shortest diameter more or less[,] out of y^e alla of which shoots y^e flower stem 4 or more inches inches long[,] produceing A perianthium divided in six parts[.] what flower it produces I cant say but there is 4 ot 5 hard ovall seeds as big as wheat grain contained in y^e periantheum [.] all y^e buds & leaves was surrounded with A thick transparent Jelly much like y^e white of an egg[.] it had A insipid tast[.][39]

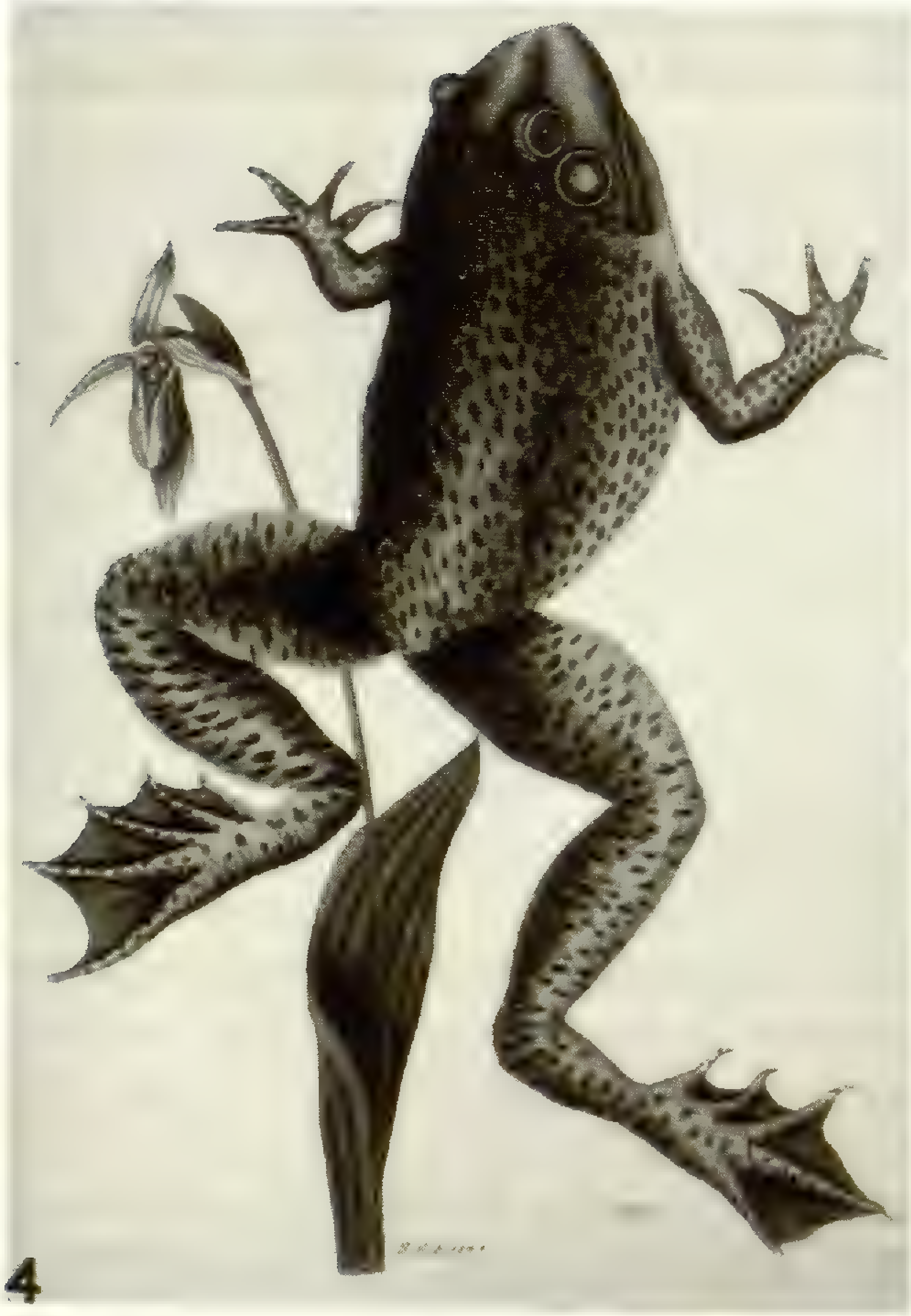
As one reads through forty years of correspondence, one is aware of tremendous growth in Bartram's understanding of botany. Bartram wrote Colonel Byrd of an early experiment in hybridization. "I have made Several successfull experiments of joyning several species of y^e same genus whereby I have obtained curious mixed Colors in flowers never before known. . . . I have by these practicall observations to open a gate into a very large field of experimental knowledge which if judiciuously improved may be a considerable adition to y^e beauty of y^e florists gardens."[40] This was only two years after the results of James Logan's experiments proving how corn is pollinated were published.[41] This was at a time when the sexual nature of plants was dimly understood.

Again, Collinson had been discouraging: "My friend Logan tells me thee art very dexterous in detecting[sic] flowers . . . This is a very curious study, and full of wonders—but must take up a great deal of time to be exact; and is a pretty amusement for those that have it hang upon their hands. But for thee and me, I think we can't allow it, without prejudice to our other weighty affairs. Yet I would not discourage thee, if thy circumstances will permit it."[42] When Bartram described his experiments to Collinson, the latter replied, "thy Experiment of the usefullness of the Farina is very Curious and Entertaining when plants of a Class grow near together they will Mix & produce a mingled species an Inztance Wee have in our Gardens Raised by the Late Thomas Fairchild who had a plant from Seed that was compounded of the Cornation[sic] & Sweet William It has the Leaves of the First and its flower Double Like the Cornation but the Size of the pinke but in cluster Like the Sweet William It is named the Mule by analogy to the Mule produced from Horse & Ass."[43]

Bartram never attempted to name presumably new species, but he did, understandably, want credit for their discovery, and felt this was lacking. He complained to Collinson: "I have received y^e second part of Phillip Millers dictionary being that present of my good friend Lord Peters. . . . but in reading Millers account of y^e Colinsonia I think he had neither done me or my province Justice for this plant hath been observed by mee this 20 years. . . . as I was y^e first that ever sent it into Europe & I think he ought to have taken care to mention y^e word y^e true place where it was sent from & who sent it. . . ."[44] (Miller had said it came from Maryland, and no individual was credited.)[45] Linnaeus also failed to give Bartram credit: *Phlox paniculata* is credited to Collinson . . . but we know from whom Collinson received it. *Phlox maculata* is credited to Kalm, but the habitat is given as Virginia, where Kalm never went. Did Kalm get the specimen from Bartram, whose herbarium he saw? In fact, although Linnaeus often cites Kalm as a source, and Philadelphia and Pennsylvania as sites, he rarely mentions Bartram as a collector.

Not only did Bartram often fail to get credit for the discovery of new species published during his lifetime, but many of the previously undescribed species which he collected evidently were not noticed as such at the time. They were described much later by Aiton, Michaux, or Marshall. Tangible evidence is in the collection of specimens which Bartram sent to Lord Petre before the latter's death in 1742, and which have recently been annotated by A. E. Schuyler and Ann Newbold.[46] *Cypripedium acaule* had been figured by Catesby . . . except that he gave it the leaves of *C. calceolus*. It is probably that which Collinson described as "The Calceolus, in the last cargo, proves at last a fine red one—a very curious flower, indeed. M Catesby has painted it."[47] Bartram had sent one earlier, but neither Collinson, Catesby nor subsequent editors of Catesby's *Natural History* identified it correctly, because of the unusual color (FIG. 4). Dr. Schuyler has spotted it as *C. acaule,* noting that young ones sometimes have a greenish hue. The plant was named *C. acaule* in 1789 by Aiton.[48]

A number of other curious oversights were included in these specimens. *Delphinium*



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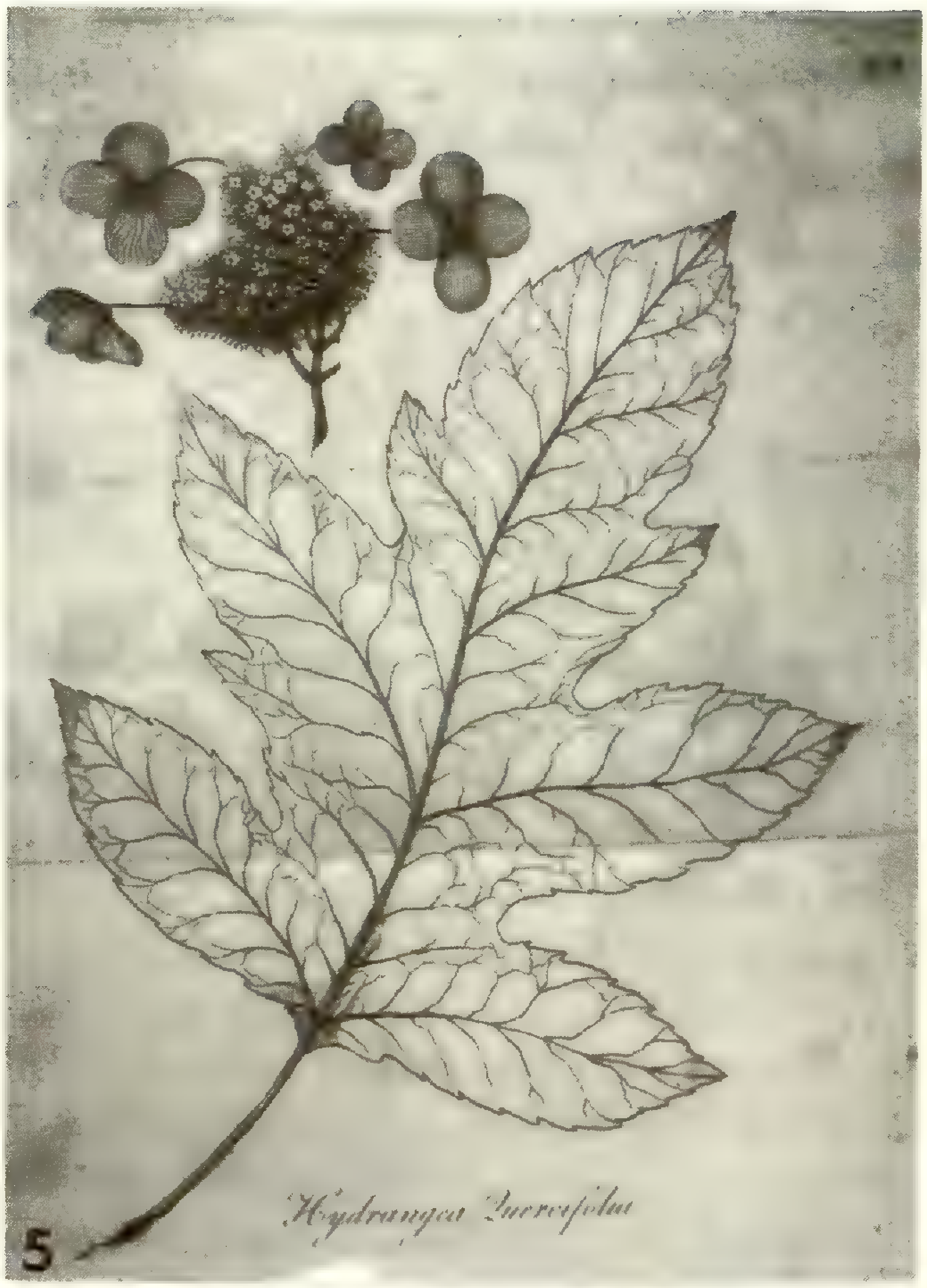

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FIG. 4. *Cypripedium acaule* Ait. as illustrated in Catesby's *Natural History*. FIG. 5. William Bartram's *Hydrangea quercifolia* Bart. illustrated in his *Travels*.

carolinianum, was described by Thomas Walter in 1788, and *D. exaltatum,* illustrated by Philip Miller in 1760 and described by Aiton in 1789.[49] And how did they miss *Prunus maritima,* which first reached print in Marshall's *Arbustum* in 1785, or *Pyxidanthera barbulata,* not described until 1803 by Michaux?[50] And how does one explain the fact that *Ilex opaca,* which Collinson was so happy to see, was different from the English holly, *Ilex aquifolium,* but was first described in 1789 by Aiton.[51] The pine barren gentian, *Gentiana autumnalis,* which he "gatherd in ye desert as [he] came from Cape may" was not described until 1776 by Linnaeus, and then from a drawing of William Bartram's reproduced in George Edwards's *Gleanings*.[52] Certainly, if Collinson had sent on John Bartram's specimen, Linnaeus would have given it recognition as a previously undescribed species. One wonders how many of Bartram's specimens actually reached Linnaeus.

Part of Bartram's lack of botanical recognition was timing, and part of it was personality and the priorities of others. Collinson, who promoted Bartram and passed his specimens along, was first of all a businessman, who made no pretense at being a taxonomist. (If he didn't believe in Bartram's speciation of oaks, however, he was not alone.) Dillenius, who had a real interest in Bartram's plants—but particularly his mosses, died in 1747. Aside from the mosses, Dillenius did not publish any of the new species. Gronovius lived until 1762, but evidently was ill in his latter years; it was his son who published the second edition of *Flora Virginica* in 1762. Daniel Carl Solander, a pupil of Linnaeus, who came to England in 1760, had a primary focus as botanist-librarian to Sir Joseph Banks. Even so, in 1762 when he surveyed Bartram's recent collections he thought "half a quire" were new genera.[53]

Bartram had a discerning eye. He himself said that if he had visited a spot, he would not discover anything new the next time. Dr. Alfred E. Schuyler recently commented, in relation to the specimens in Lord Petre's herbarium, that he was "not working with an ordinary assemblage of specimens. Included are plants of the seashore, pine barrens, and mountains, plants of acid substrates and limestone, and plants of aquatic and terrestrial habitats."[54]

John Bartram may have been a "simple farmer" . . . but in the same sense that Sam Ervin was a "simple country lawyer." Bartram was, after all, a founding member of the American Philosophical Society, and a 1739 letter suggests that it may have been just as much his idea as Franklin's.[55] He was a man of his time, for his time, and ahead of his time.

William Bartram (1739–1832), was born shortly after his father embarked upon his botanical career. He studied at the Academy of Philadelphia (Now the University of Pennsylvania) from 1752–1755. One suspects that William's upbringing had a stronger influence than his formal education. He grew up meeting (or having the opportunity to meet) Cadwallader Colden, Alexander Garden, John Mitchell, Benjamin Franklin, James Logan, and Peter Kalm. He must have been aware of correspondence with Gronovius, Mark Catesby, Philip Miller, Peter Collinson, and Sir Hans Sloane. William was only fourteen at the time of the visit to Cadwallader Colden and his daughter Jane in 1753.

It was the next year that Bartram sent Billy's drawings of:

> . . . most of our real species of oaks & all our real species of birches with an exact discription of thair perticular charracters not according to gramer rules or science but nature he hath all our oaks & my distinguishing characters of them Pray compair them with Catesbys draughts & see how wildy & unaturaly *he* hath placed y^e acrons he makes no distinction of summer & winter acrons nor how y^e thay [sic] or y^e leaves grow on a twig or how y^e nerves projects yet how is his work aplauded . . . he seems to know little of thair natural growth but hath done all at random exept y^e outlines of y^e leaves. . . .[56]

John's letters are full of references to his worrisome son:

> My son William is just turned sixteen It is now time to propose some way for him to get his living by. I don't want him to be what is commonly called a gentleman. I want to put him to some business by which he may, with care and industry, get a temperate, reasonable living. I am afraid that botany and drawing will not afford him one, and hard labour don't agree with him. . . .[57]

Collinson gave stern advice about getting Billy a job, but at the same time found patrons for him, the first being the Duchess of Portland.

Billy's interest in natural science was even broader than his father's, for it extended into ornithology. He began sending drawings of plants, birds, turtles: the latter Collinson had published in the *Gentleman's Magazine* (which, it seems, nearly everybody read).

William first worked for Captain Child, a Philadelphia merchant, then went down to Cape Fear, North Carolina, to work for his uncle William Bartram, but young William was not very successful as a storekeeper. At the end of the expedition of 1765–66 to the Carolinas and Florida, William decided to stay and try his hand at running a plantation. His father financed it, then continued to send money, millstone, tools, etc, with minimal response from young William to his father's letters. Within several months Henry Laurens found William suffering from ill health and his crops in poor shape. "A gentle, mild young man, no wife, no friend, no companion, no neighbour, no human inhabitant within nine miles of him . . . scant of the bare necessaries, and totally void of all the comforts of life, except an inimitable degree of patience, for which he deserves a thousand times better fate; an unpleasant, unhealthy situation. . . .''[58] It was neither as a merchant nor as a planter that Billy was to find success.

William Bartram's first Florida trip, with his father in 1765–66, did not result in any writing or drawing that we have knowledge of, but the experience must have influenced Billy. His later trip, which was to be so important to botany, ornithology and literature, was in the footsteps of the first. The expedition was suggested and underwritten by Dr. John Fothergill, after he had taken over some of the importation of American plants.

William left for the south in 1773, sent back reports, then did not write at all; his family was afraid that he had died. Among other discoveries, he found the oakleaf hydrangea (*Hydrangea quercifolia*), and the *Franklinia* in bloom (FIG. 5). William sent a report to Dr. Fothergill, based on the journals Fothergill had asked him to keep.[59] Bartram later wrote a book, *Travels Through North and South, Carolina, Georgia, East and West Florida.*[60] This work was to influence Wordsworth and Coleridge, and was subsequently published in Philadelphia, London, Paris, and Leyden.[61] In it William described Indians, alligators, the general ecology in an interesting mix of romantic prose and scientific accuracy; sometimes one style predominated, and sometimes the other.

> The fiery Azalea, flaming of the ascending hills or wavy surface of the gliding brooks; the epithet fiery, I annex to this most celebrated species of Azalea, . . . the clusters of the blossoms cover the shrubs in such incredible profusion of the hillsides, that suddenly opening to view from dark shades, we are alarmed with the apprehension of the hill being set of fire. This is certainly the most gay and brilliant flowering shrub yet known.[62]

William's description of the *Franklinia* is more precisely botanical:

> In the course of these excursions and researches, I had the opportunity of observing the new flowering shrub, resembling the Gordonia,* in perfect bloom, as well as bearing ripe fruit. It is a flowering tree, of the first order for beauty and fragrance of blossoms: the tree grows fifteen or twenty feet high, branching alternately; the leaves are oblong, broadest towards their extremities, and terminate with an acute point, which is generally a little reflexed; they are lightly serrated, attenuate downwards and sessile, or have very short petioles; they are placed in alternate order, and towards the extremities of the twigs are crouded[sic] together, but stand more sparsedly below; the flowers are very large, expand themselves perfectly, are of a snow-white colour, and ornamented with a crown or tassel of gold coloured refulgent stamina in their centre; the interior petal or segment of the corolla is hollow, formed like a cap or helmet and entirely includes the other four, until the moment of expansion; its exterior surface is covered with a short silky hair; the borders of the petals are crisped or plicated: these large, white flowers stand single and sessile in the bosom of the leaves, which being near together towards the extremities of the twigs, and usually many expanded at the same time, make a gay appearance; the fruit is a large, round, dry, woody apple or pericarp, opening at each end oppositely by five alternate fissures, containing ten cells, each replete with dry woody cuniform seed. This very curious tree was first taken notice of, about ten or twelve years ago, at this place, when I attended my father (John Bartram) on a botanical excursion; but, it being then late in the autumn, we could form no opinion to what class or tribe it belonged.
>
> We never saw it grow in any other place, nor have I ever since seen it growing wild, in all my travels, from Pennsylvania to Point Coupe, on the banks of the Mississipi, [sic] which must be allowed a very singular and unaccountable circumstance; at this place there are two or three acres of ground where it grows plentifully. . . .
>
> *On first observing the fructification and habit of this tree, I was inclined to believe it a species of Gordonia, but afterwards, upon stricter examination, and comparing its flowers and fruit with those of the Gordonia lasianthus, I presently found striking characteristics abundantly sufficient to separate it from that genus, and to establish it the head of a new tribe, which we have honoured with the name of the illustrious Dr. Benjamin Franklin. *Franklinia Alatamaha.*[63]

William Bartram arrived back in Philadelphia, just before his father died in 1777, worrying about the British harming his garden as they entered Philadelphia. They did not, and in fact, treated it with great respect.

William never traveled again. He was offered the position of professor of botany at the University of Pennsylvania, but turned it down, due to "ill health"—and lived another forty years. Jefferson offered him a position as naturalist on the Lewis and Clark expedition, but William also turned that down; at that point he was over sixty, and that trek was to be more strenuous than his father's last trip to Florida—even though Benjamin Smith Barton assured him it would "not be fatiguing . . . a great part of it will be by water."[64] Though William seemed to have lacked his father's drive, these offers show the great respect in which he was held.

John Bartram left his garden to John Jr., the practical one, but William continued to live there. He persevered in his illustrations; the best known were for Benjamin Smith Barton's *Elements of Botany*[65] (FIG. 6). He seems to have retired to his garden as a resident botanical sage, very much sought out by the next generation of American botanists. Joseph Ewan feels that his early retirement may have been brought on by the disbelief in some of his descriptions in the *Travels*, as well as "Solander's pigeonholing of the drawings and specimens made for Dr. Fothergill."[66]

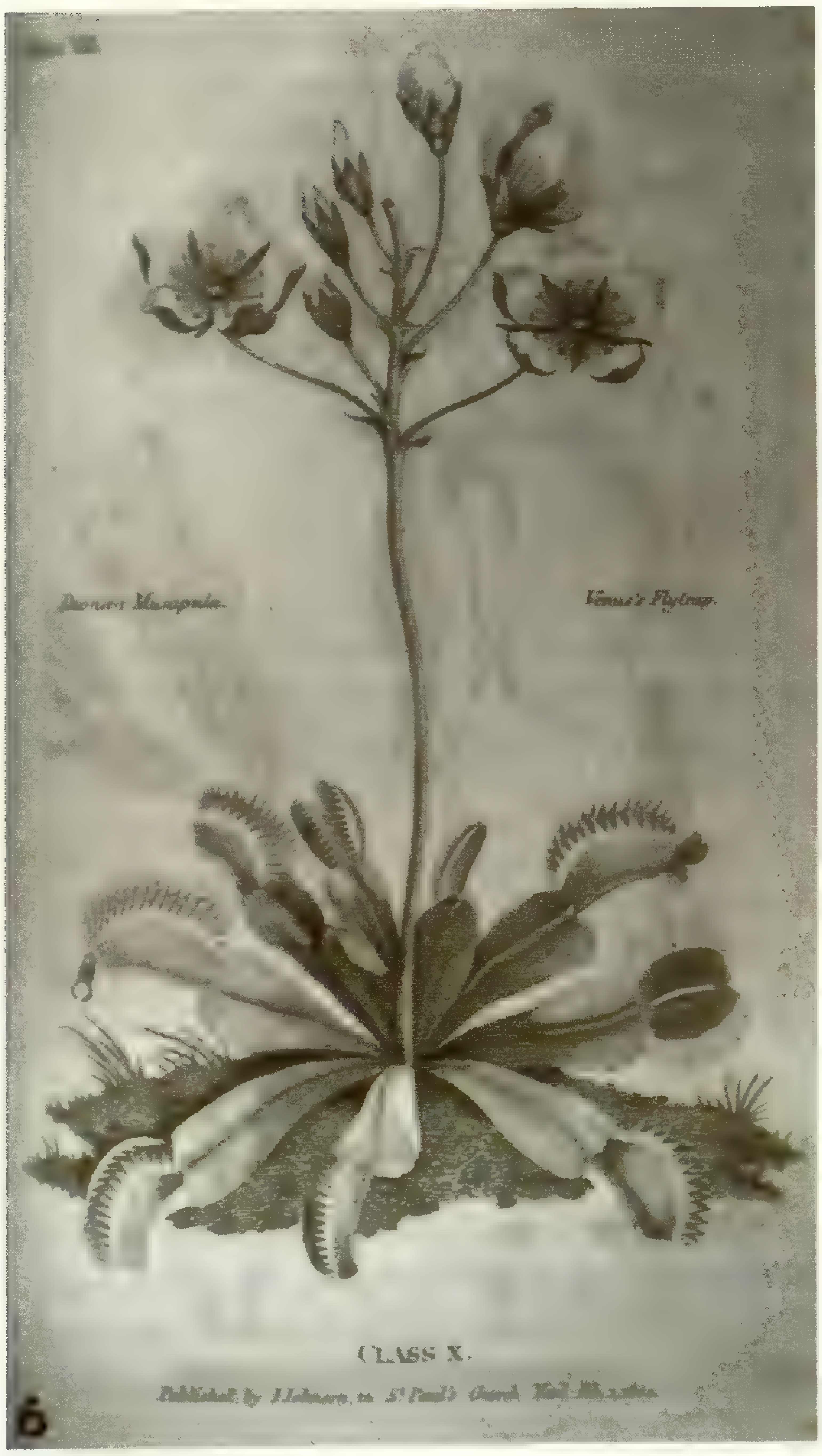
Dionaea Muscipula.
Venus's Flytrap.
CLASS X.
6

FIG. 6. William Bartram's *Dionaea muscipula* Ellis, Venus's-Fly trap in Benjamin Smith Barton's *Elements of Botany*.

In 1788, Billy wrote:

> I collected these specimens amongst many hundred others about 20 years ago when on Botanical reserches in Carolina Georgia and Florida duplicates of which I sent to Doctor Fothergill; very few of which I find have entered the *Systema Vegetabilium* [of Linnaeus], not even in the last Edition.
>
> The number of specimens that I sent were submitted to the examination of Doctor Solander which by the returns I received from the Doctor appeared most of them to be either New Genera or Species; soon after Doctor Solander deceas'd & Doctor Fothergill soon after followed him. I have never learn'd what became of the specimens . . . expecting or desiring no other gratuity than *the bare mention of my being the discoverer,* . . . But with a perfect Sense of gratitude I with pleasure acknowledge that the Noble Fothergill liberally supported me whilst in his employ with ample pecuniary assistance.[67]

With Linnaeus's acceptance of *Gentiana autumnalis* as a new species, merely from William Bartram's drawing as reproduced by Edwards, one wonders how many of William's other drawings or specimens, so carefully sent to Collinson, Fothergill, and Solander, that Linnaeus ever saw.

William's drawing of the Pine Barren gentian was of minor interest to George Edwards, the father of British ornithology, to whom William sent skins, descriptions and drawings. Solander may have sat on William's botanical specimens, but Edwards recognized the importance of Bartram's contribution in his *Gleanings of Natural History*.[68] He even copied Billy's drawings, without the supporting skins, because, as he wrote: "tho I have not seen the bird [marsh hawk] myself, I have great reason to think Mr. Bartram very correct in his drawing, and exact in his coloring, having compared many of his drawings with the natural subjects and found a good agreement between them."[69] William evidently inherited his father's sharp eye, honed by the latter's training, for many of the younger Bartram's specimens and illustrations were of new species.[70]

William Bartram's American ornithological pupil was Alexander Wilson, often considered the father of American ornithology; if this is so, then William Bartram is the grandfather: William Bartram even gave the young schoolteacher, whose school was upriver at Gray's Ferry, drawing lessons. Although the emphasis was on birds, plants were included:

> Dear Sir, [Wilson wrote in 1803]
>
> I have murdered your Rose. I traced the outlines with great patience but in colouring and shading I got perfectly bewildered. After I have gained a little more practice I shall make one desperate attempt more on these roses. I hope you will excuse my present attempt more on these roses. I hope you will excuse my present failure. . . .[71]

William Bartram's circle of influence may have been smaller than his father's abroad, but was stronger at home. He was mentor to the next generation of botanists. As William, on his second southern expedition, followed the route he and his father took originally, so did many botanists follow William's trail, beginning with André Michaux, André François Michaux and John Fraser, across the Carolina low country in 1787.[72] Perhaps Bartram discussed this when Michaux *père* visited Bartram's garden on his arrival in Philadelphia in 1786. It was the Michaux's who named the *Pinckneya* which the Bartrams had found earlier, near the *Franklinia*. Thomas Nuttall was another botanist whom Bartram influenced; Nuttall often stayed with the Bartrams when he working on his *Genera*. He, too, must have received advice from Bartram on his southern trip of 1815–16, for "he followed a road in Georgia that his venerable friend had taken in his youth."[73]

By the early nineteenth century, the "Bartram Trail" had indeed begun. Pursh's *Flora* shows the footprints well, as he describes many species found on or near the banks of the Altamaha River, where specimens were collected not only by the Michaux, but also Thomas Walter and John Lyon.[74] (Bartram's footsteps were followed into the twentieth century, when Mary G. Henry used his *Travels* to help locate *Rhododendron flammeum*. Subsequently she always took his *Travels* on her plant collecting trips in the southeast.)[75]

Others in William Bartram's circle included Henry Muhlenberg and William Baldwin. Muhlenberg worked to have Bartram's plants validated, sending him (more than once evidently) a list of plants mentioned in the *Travels*, on which he would be "extremely obliged . . . for any information on [them]. . . . You as the first Finder ought to have credit for the finding and none of you Names should be changed in a later work. . . ."[76] Muhlenberg also wrote to William Baldwin, then living in Georgia, on many occasions, asking him to trace Bartram's plants. This Baldwin did, "Could I have extended my excursion a little more westerly, I should in all probability have found many of Bartram's doubtful plants. I am happy to say, that his authority is good in most instances, where I have had it in my power to travel over the same ground."[77]

As with his father, few of William Bartram's discoveries bear his name. Even the *Franklinia* bears Marshall's name, although the latter gives the credit for its discovery to Bartram. Marshall's *Arbustum Americanum* was published before Bartram's *Travels* came into print. Most of William's names in the *Travels* have been passed over as *nomina nuda*. In 1944, Edward Merrill found 130 "new" Bartram binomials which he felt should be accepted.[78] Joseph Ewan has argued that "the case for admitting those Bartram plant names which qualify under current rules of scientific nomenclature is strong."[79]

Zaccheus Collins, a Philadelphia merchant and botanist, said of William that "Mr. William Bartram has a Library within himself. Some great and famous botanists have robbed [him] of his Honey, without thanking him for his trouble."[80]

William's portrait, in his later years, by Charles Wilson Peale portrays a gentle, sensitive man. The gentle quality is referred to by many of his contemporaries, as well as "the amiability of his character and the obliging readiness with which he communicates to others the result of his studies and observations."[81] This "readiness to communicate" strengthened a generation of nineteenth century American botanists, most of whom gave tribute to him in their publications.

One of the clearest descriptions of William Bartram and his contributions comes from his contemporary and fellow botanist, William P. C. Barton:

> He is one of the most ambitious lovers of nature I have ever seen. With a mind keen, penetrating and vivacious, he applied himself in early life, to the study of botany, and indeed natural history generally; but more particularly devoted himself to the study of the manners and habits of our birds, and other interesting points of inquiry connected with their history and migrations. In his travels to Florida, he relates these in all the fervour of a real lover of nature's work and with such innocent enthusiasm that we cannot fail to love and venerate the author.[82]

As under John Bartram Senior, the garden was still a Mecca in William's time; George Washington visited it during the Constitutional Convention . . . and so did everyone else of note. Catalogues were issued; clients were plentiful, abroad and at home. And the garden continues today, kept alive through the efforts of: John Junior's daughter and son-in-law, the Carrs; the Eastwicks who purchased the property subsequently; the descendents of the Bartrams who formed the original Bartram Association;

and through the influence of Thomas Meehan and the City of Philadelphia.[83] Today it is being restored with great thoughtfulness and determination by the John Bartram Association. One can still enjoy the sweep to the Schuylkill River, and the somewhat disorderly profusion of plant specimens as in the Bartrams' time. It is an oasis in an urban industrial setting, and its continuance is one of today's minor miracles, and a tribute to the contributions and characters of John and William Bartram and those who recognized their unique abilities.

NOTES

1. Hector St. John de Crevecoeur, "Letter from Mr. Iw—n Al—tx, a Russian Gentleman; describing the visit he paid at my request to Mr. John Bertram [sic] the celebrated Pennsylvania Botanist" (1782) in William Darlington, *Memorials of John Bartram and Humphry Marshall* (1849; reprint ed., with introduction by Joseph Ewan, Philadelphia, 1967), p. 60. Stevenson W. Fletcher, *Pennsylvania Agriculture and Country Life, 1640–1840* (Harrisburg, Pennsylvania Historical and Museum Commission, 1971), p. 124.
2. In 1769, John Bartram described making manure water of "old-lime, ashes horse-dung, etc," and enriching his fields with "red clover, which is the greatest meliorator of our lands." Darlington, *Memorials*, p. 50.
3. Bartram denied the Virgin Birth; theologically, he was a Unitarian ahead of his time.
4. de Crevecoeur, "Letter" in Darlington, *Memorials*, p. 52.
5. "Though he was bred a farmer, or husbandman, as a means of procuring a subsistence, he pursued his avocations as a philosopher, being ever attentive to the works and operations of Nature . . ." William Bartram, "Some Account of the late Mr. John Bartram of Pennsylvania," *Philadelphia Medical and Physical Journal* (Philadelphia, 1804), p. 117.
6. William Penn had written: "The country life is to be preferred for here we see the works of God. . . . God's works declare his power and his goodness." This, and the fact that Quakers were denied other outlets, such as music or art, helps to explain why such a high percentage of Quakers were interested in gardening or natural history, both in America and in England, as well as why so many of them were interested in native plants. William Penn, *Some Fruits of Solitude* (1693; reprint, Richmond, Indiana: Friends United Press, 1978), p. 37.
7. It was to this point that John Evelyn published his *Sylva* in 1664.
8. Carl Linnaeus, *Systema Naturae* (Leyden, 1735).
9. Mark Catesby, *The Natural History of Carolina, Florida and the Bahama Islands*, 2 vols. (London, 1731–1743).
10. Peter Collinson's letters, edited by Alan Armstrong, with the assistance of Elizabeth McLean and Jean O'Neill, are due to be published shortly. They show the international breadth of his friendships and interests.
11. Joseph Pitton de Tournefort, *The Compleat Herbal:, or, the botanical institutions of Mr. Tournefort*, Eng. trans., 2 vols. (London, 1716–1719–30).
12. Peter Collinson [PC] to John Bartram [JB], Dec 14, 1737, Bartram Papers [BP], II, 41, Historical Society of Pennsylvania. [HSP]
13. JB to PC, May, 1738, BP, I, 14, HSP.
14. PC to JB, May 20, 1739, BP, II, 48; Mar 3, 1742, BP, II, 58, HSP. Bartram also had Bradley and Ellis on husbandry. Bartram's friends and patrons realized that the "Acknowledgment" he most appreciated was books.
15. Edmund Berkeley and Dorothy Smith Berkeley's account of the *Life and Travels of John Bartram* (Tallahassee, 1982); Joseph Ewan's introduction and the Bartram-Collinson correspondence in William Darlington's *Memorials;* and Francis Harper, ed., John Bartram, "Diary of a Journey Through the Carolinas, Georgia and Florida," *Transactions of the American Philosophical Society*, New Series, XXXIII (1944), Part I.
16. While still a minor, Lord Petre had helped underwrite William Houstoun's explorations in the Caribbean; Houstoun named *Petrea* for him.
17. John Bartram, *Observations on the Inhabitants, Climate, Soil, Rivers, Productions, and other Matters Worthy of Notice made in travels from Pensilvania to Onondago, Oswego and the Lake Ontario in Canada, with account of Niagara by Peter Kalm* (London, 1751).

18. *Ibid,* p. i.
19. A list of Bartram's clients is found in Berkeley and Berkeley, *Life and Travels*, pp. 311–318.
20. JB to PC, Nov 11, 1763, Darlington, *Memorials,* p. 256.
21. PC to JB, Feb 5, 1736, BP, II, 13, HSP.
22. PC to JB, Sep 1, 1741, BP, II, 60, HSP.
23. John Hendley Barnhart, "Significance of John Bartram's Work to Botanical and Horticultural Knowledge," *Bartonia,* special issue, supplement to no. 12 (1931), pp. 27–28.
24. *Ibid,* p. 28.
25. Dr. John Fothergill to Humphry Marshall, Sep 1771, Darlington, *Memorials,* p. 508.
26. Peter Kalm, *Travels into North America,* trans. John Reinhold Forster (1772; reprint edition, Barre, Mass., 1982), p. 64.
27. JB to PC, Nov 1739, BP, I, 19: 5, HSP. Although Bartram's name does not appear on the specimen, Gronovius clearly credits Bartram. "Tertiam speciem ad sin um Dellaware Pensilvaniae in venit Joh. Bartramus, qui radices seminaque ad Petrum Collinson um missit, in cujus horto feliciter crescunt." John Frederik Gronovius, *Flora Virginica* (Lugduni Batavorum, 1762), p. 147.
28. Specimen XII-59 in Lord Petre's herbarium, now at the Sutro Library in San Francisco.
29. JB to PC, appended to his "Journal of Trip to the Catskills," 1753, BP, I, 35, HSP.
30. Specimen XII-50 in Lord Petre's Herbarium, Alfred E. Schuyler and Ann Newbold, "Vascular Plants in Lord Petre's Herbarium Collected by John Bartram," *Bartonia* no. 53 (1987), pp. 41–43.
31. Humphry Marshall, *Arbustum Americanum: The American Grove,* (1785; reprint ed. with introduction by Joseph Ewan, New York, 1967), and *Catalogue Alphabetique Des Arbres et Arbrisseaux,* trans. M. Lézermes, (1788; reprint ed., New York, 1967).
32. Linnaeus, *Species Plantarum* (Stockholm, 1753), II, p. 1058.
33. Collinson may have been patronizing, but he was less so than some of his contemporaries toward colonists. John Ellis, for example, felt they should be busy raising indigo, rice and cotton for the Mother Country.
34. PC to JB, 13 Feb 1753–54, BP, II, 88, HSP.
35. It was not only Collinson. Marshall included seventeen species of oaks in his *Arbustum,* but his French translator of the *Catalogue Alphabetique Des Arbres,* only knew eight, and felt that the others were varieties. "De dix-sept espèces de chênes qu'indique M. Marshall, nous n'en connoissons qu'un petit numbre, qui sont, le chêne blanc, le noir, deux rouges, dont un de montagne, deux a seul feuilles de saule, & un chêne a feuilles de chataignier. Reste a savoir si toutes les autres sont des espèces bien distinctes, ou simplement des variétés des premiers . . . Comme les chênes se propagent naturellement par leu lerus graines, n'y a-til pas à craindre que la plupart des variétés soient purement séminales?" pp. 198–199.
36. JB to Philip Miller, Apr 20, 1755, BP, I, 35: 21, HSP.
37. JB to PC, Jul 1754, BP I, 33, HSP. This would have been John Hill's, *A General Natural History, Vol II: A History of Plants* (London, 1751). In this, Hill's first botanical publication, he introduced the Linnaean system to England. See Blanche Henrey, *British Botanical and Horticultural Literature before 1800* (London, 1975), II, pp. 90–98 for further discussion of Hill.
38. "The plant here so well described, is no doubt the *Brasenia peltata,* Pursh [= *B. Schreberi*]. indigenous in the very stream on whose banks John Bartram resided." William Darlington, quoted in Harper, *JB Diary, APS* p. 85.
39. Harper, *JB Diary, APS,* Jul 25, 1765, p. 16.
40. JB to "Coll Byrd," 1739? BP, I, 17: 4, HSP.
41. *Philosophical Transactions,* XXXVI (1737), p. 192.
42. PC to JB, Dec 14, 1737, BP, II, 41, HSP.
43. PC to JB, Jul ?, 1740, BP II, 53: 1–4, HSP.
44. JB to PC, late in 1739, BP, 1, 20: 6, HSP.
45. *Collinsonia* is first described by Linnaeus in *Hortus Cliffortinaus* (Amsterdam, 1737). p. 14. No collector is mentioned, simply "Crescit in America septentrionali. . . ." In *Species Plantarum,* Linnaeus cites rather "Cold. noveb," [*Plantae Coldenghamiae in provincia Noveboracensi Americes spont crescentes . . . descripsit Conwallader* [*sic*] *Colden* (Upsala, 1743)]. Peter Kalm certainly knew "Mr. Bartram was the first who discovered it and sent it into Europe." Peter Kalm, *Travels,* p. 105.
46. Schuyler and Newbold, "Lord Petre's Herbarium," *Bartonia,* pp. 41–43.

47. Specimen XI-37 in the Petre Herbarium. Catesby had two illustrations of *Cypripedium acaule*. PC to JB, Jun 10, 1740, Darlington, *Memorials*, p. 136. The "fine red one," with leaves of *C. calceolus* is on App. 3 of Catesby's *Natural History*. The greenish variety is illustrated on II, 72, with leaves correctly drawn, and has been misidentified as *C. calceolus* through the years. Clayton had sent a "Calceolus flore maximo rubente purpureis," which Gronovius had lumped with *C. calceolus*. Gronovius, *Flora Virginica*, p. 140.
48. William Aiton, *Hortus Kewensis*, 3 vols. (London, 1789).
49. Specimens XI-43 and XI-44 in the Petre herbarium. Thomas Walter, *Flora Caroliniana* (London, 1788), p. 155. Philip Miller, *Figures of the most beautiful, useful, and uncommon plants described in The gardeners dictionary* (London, 1755–1760). Aiton, *Hortus Kewensis*.
50. Specimen XI-84 in the Petre Herbarium. André Michaux, *Flora Boreali-Americana*, (Paris, 1803), I, p. 152.
51. Specimen XII-59 in the Petre Herbarium. Aiton, *Hortus Kewensis*.
52. Specimen XII-53 in the Petre Herbarium. George Edwards, *Gleanings of Natural History* (London, 1758) Plate 255. Linnaeus, *A catalogue of the Birds, Beast, Fishes, Insects, Plants & contained in Edwards's Natural History, . . . with their Latin Names*. (London, 1776).
53. Joseph Ewan, in Darlington, *Memorials*, p. xi.
54. Schuyler and Newbold, "Lord Petre's Herbarium," *Bartonia*, p. 43.
55. Bartram wrote to Collinson: suggesting an "[acad]emy or society" where "most ingenious & Curious men [could study] "naturall secrets arts & syences . . . [and] communicate—discoveries freely." 1739, BP, I, 38, HSP.
56. JB to PC, Nov 5, 1754, BP 1, 37, HSP.
57. JB to PC, Apr 27, 1755. Darlington, *Memorials*, p. 199.
58. Henry Laurens to JB, Aug 9, 1766, Darlington, *Memorials*, pp. 438–442.
59. William Bartram, "Travels in Georgia and Florida, 1773–1774, a Report to Dr. John Fothergill," annotated by Francis Harper, *Transactions of the American Philosophical Society*, New Series, XXXIII, Part II (1943). The introduction contains an excellent, short biography of William Bartram. A fully adequate biography has yet to be written.
60. William Bartram, *Travels Through North and South, Carolina, Georgia, East and West Florida*. (Philadelphia, 1791).
61. John Livingston Lowes, in the *The Road to Xanadu* (New York, 1927) examines William Bartram's literary influence in detail.
62. William Bartram, *The Travels of William Bartram, Naturalist's Edition*, ed. Francis Harper (New Haven, 1958), pp. 204–205.
63. William Bartram, *Travels*, ed. Harper, pp. 295–296.
64. "The journey will not be fatiguing. Wim. Freeman tells me that a great part of it will be by water. Come on. You are not too old. You have sufficient youth, health and strength for the journey. You will render great and new services to Natural Science. Remember that your venerable father continued to take Botanical tours, long after he had reached your age." Benjamin Smith Barton to William Bartram, August 1803, BP, I, 12, HSP.
65. Benjamin Smith Barton, *Elements of Botany*, 2 Vols. (Philadelphia, 1812).
66. Joseph Ewan, *William Bartram, Botanical and Zoological Drawings, 1756–1788* (Philadelphia, 1968), p. 7. Ewan's introduction provides an excellent background to Bartram's influence in Natural Science.
67. To a Mr. Barclay, Nov 1788, quoted in William Bartram, "Report to Dr. John Fothergill," Harper, *Transactions APS*, p. 130.
68. George Edwards, *Gleanings of Natural History*, 3 Vols. (London, 1758–1764).
69. Edwards, *Gleanings*, Vol. II, p. 174.
70. "[William Bartram sent] at one time . . . fourteen American Birds, mostly non-descripts, with some short accounts and observations concerning them, in a letter dated Pensilvania, Jun 1756." Edwards, *Gleanings*, II, 192.
71. Alexander Wilson to William Bartram, Nov 10, 1803, in Clark Hunter, *The Life and Letters of Alexander Wilson* (Philadelphia, 1983), p. 204.
72. Henry Savage Jr., and Elizabeth J. Savage, *André and François André Michaux* (Charlottesville, 1986), p. 65.
73. Jeannette E. Graustein, *Thomas Nuttall, Naturalist* (Cambridge, Mass., 1967), p. 97.
74. Frederick Pursh, *Flora Americae Septentrionalis* (London, 1814).

75. Josephine deN Henry, interview, May 1991. Many of Mrs. Henry's collections were established in her "wild garden," now the Henry Foundation for Botanical Research in Gladwyne, PA.
76. Henry Muhlenberg to William Bartram, Jan 29, 1810. BP, IV, 91, HSP.
77. William Baldwin to Henry Muhlenberg, May 27, 1817, *Reliquiae Baldwinianae: Selections from the Correspondence of the Late William Baldwin, M.D.*, ed. William Darlington (1843; reprint ed., with introduction by Joseph Ewan, New York, 1969), p. 230.
78. E. D. Merrill "In Defense of William Bartram's Binomials," *Bartonia*, XXIII (1944), pp. 10–35.
79. Ewan, *William Bartram Drawings*, p. 13.
80. Quoted in Harper, *Travels* p. xxxiv.
81. François Michaux, *North American Sylva* (Philadelphia, 1817).
82. William P. C. Barton, *Vegetable materia medica of the United States; or a medical botany* (Philadelphia, 1818) Vol. II, p. 107–108.
83. Thomas Meehan had been gardener to Andrew M. Eastwick, who bought Bartram's Garden from John Jr.'s daughter and his son-in-law, Anne and Robert Carr. Meehan subsequently became a landscaper, horticulturist and editor of note. It was through his influence, when on City Council, that the City Parks Association was formed. Bartram's Garden was the first such property purchased for the city.

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On the Typification of Seven Names in *Anemone* (Ranunculaceae) Proposed by Linnaeus

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ANEMONE DICHOTOMA L., *A. CANADENSIS* L., AND *A. PENSYLVANICA* L.

Anemone dichotoma (Linnaeus 1753) has been consistently applied to a plant of eastern Asia since proposed. For a brief period, it was also used for a similar species from eastern North America. However, since Linnaeus published *A. canadensis* (1768: 231) and *A. pensylvanica* (1771: 247), the American element has been known by one or the other of these names.

Britton (1891: 228) lectotypified *Anemone dichotoma* on the specimen at LINN, 710.23 (Savage 1945). Stearn (1957: 117), apparently unaware of Britton's work, proposed a lectotypification on a specimen in the Burser herbarium (Vol. IX: 138; UPS). The Burser specimen was collected at an early French colony along the St. Lawrence River in southern Canada (Juel 1931), and is a specimen of the species that has been called *A. canadensis*. Fortunately, Britton's typification has priority over that of Stearn for Stearn's choice would lead to *A. dichotoma* replacing *A. canadensis*, apparently leaving the Asiatic species without a name.

When Linnaeus (1768) proposed *Anemone canadensis*, he indicated that material had been sent to him from Pennsylvania via John Hope, who was Professor of Botany and Regius Keeper at Edinburgh from 1761 to 1786. There is nothing in the correspondence files at LINN to indicate whether specimens or seeds were sent, but probably both. The locality suggests Hope had received the material from John or William Bartram of Philadelphia, who were shipping plants and seeds to him during this period (Darlington 1849). Linnaeus' phrase name and description seem to apply to a specimen at LINN (710.22) annotated "philadelphica" (an unpublished epithet) by Linnaeus and "pensylvanica" by James Edward Smith.

In 1771, Linnaeus proposed *Anemone pensylvanica*, indicating that he knew it from garden material grown at Uppsala from seeds gathered in Canada. It seems likely that the seeds were part of the material Hope sent to Linnaeus prior to 1768, which Linnaeus had described as *A. canadensis*. Britton (1891: 228) believed this to be the case, and noted "at the place of first publication of this plant Linnaeus says of its origin: 'Hab. in Pennsylvania, D. Hope'; but when he republished it in the *Mantissa* three years later he says, '*Habitat in* Canada . . . H.U.' (Hortus Upsaliensis), curiously interchanging the locality and the specific name." A close reading of the two phrase names and the descriptions shows that they are remarkably similar:

canadensis: Anemone caule dichotomo, foliis sessilibus: infirnis ternis trifidis incisis.
Habitat in Pennsylvania. *D. Hope*.
Simillima Anem. dichotomae, *ut ignotum fallat; tantum differt*[.] Foliis, *sub prima dichotomia caulis, ternis; nec binis. Corolla subtus alba; nec rubicunda.* Antherae *flavae; nec fulvae.* Fructus *capitulo globoso; nec ovato:* Seminibus *subulatis arista ipso semine longiore recta; nec mucrone brevissimo recurvato.*

pensylvanica: ANEMONE caule dichotomo, foliis sessilibus amplexicaulibus trifidis incisis: inferioribus ternis.
Habitat in Canada. ♃ H.U.
Simillima A. dichotomae, *ut incautum fallat, sed differt:*
Folia *ad primum dichotomiam caulis (non bina) terna, sessilia, magis venosa, minus horizontalia.*
Flores *toti albi (non subtus rubicundi), majores.*
Antherae *flavae (non fulvae).*
Fructus *globosus, seminum apicibus subulatis (non mucrone minuto recurvo) undique exstantibus.*

Linnaeus would appear to have had the same species in mind, but as *Anemone canadensis* was not explicitly mentioned in the protologue of *A. pensylvanica* in 1771, the latter cannot be regarded as superfluous. Perhaps significantly, *A. canadensis* is cited as a synonym of *A. pensylvanica* in the thirteenth edition of the *Systema vegetabilium* (Linnaeus 1774).

Britton (1891: 228) stated that the "type of *A. Pennsylvanica,* L., [is] in Herb. Linn.," but as no single specimen in the Linnaean herbarium can be associated unequivocally with the name (see sheets 710.21, 710.22), Britton's comments do not constitute a valid typification. In the absence of any authentic material from Hope, we hereby designate 710.22 (LINN!) as the neotype of *A. canadensis.* We also neotypify *A. pensylvanica* on 710.22 (LINN!) as no authentic garden material from Uppsala has been found. The effect of this is to maintain *A. pensylvanica* as a synonym of *A. canadensis,* and to maintain *A. canadensis* as the correct name for the eastern North American plant.

ANEMONE QUINQUEFOLIA L. AND *A. NEMOROSA* L.

In his protologue for *Anemone quinquefolia,* Linnaeus (1753: 541) cited a Plukenet (1696: 310) phrase name and its associated illustration (Plukenet 1691: t. 166, f. 3) in synonymy, and also referred to a Pehr Kalm specimen. Linnaeus annotated the only Kalm specimen now in LINN which fits his description of *A. quinquefolia* (710.26!) with the epithet of a European *Anemone,* "nemorosa." This specimen, with five sepals and tripartite and serrate involucral bracts, more or less conforms to typical *A. quinquefolia,* and it may be that Linnaeus misannotated the sheet. Infrequently, individuals of *A. nemorosa* can have five sepals and tripartite involucral bracts, so it is possible 710.26 is an atypical specimen of that species. While it is known that Kalm collected in Europe, there is no evidence of any of his European specimens being in any of the modern Linnaean herbaria. Unfortunately, the specimen lacks a rhizome, so it is difficult to make a positive identification.

The one specimen now at LINN annotated "quinquefolia" (710.25) was added after the collection arrived in London. At that time, James Edward Smith reviewed the holdings of the herbarium and attempted to account for all Linnaean species. When a particular species was missing, Smith often obtained a representative specimen from the Banks herbarium (Savage 1945; Stearn 1957). This appears to have been the case for *A. quinquefolia,* as Smith marked the sheet "ex HB" (i.e. "ex Herb. Banks"). As the specimen was unavailable to Linneaus in 1753, it is not original material.

To preserve the name for the North American species, *Anemone quinquefolia* is lectotypified here by the illustration from Plukenet's *Phytographia* (1691: t. 166, f. 3). It is in complete agreement with Linnaeus' description; in addition, Plukenet has represented the rhizome with scaly teeth common in the species. The illustration is a near reproduction of a Banister illustration (Ewan and Ewan 1970), to which Plukenet has added the rhizome.

Anemone nemorosa (Linnaeus 1753) was described with a diagnosis taken unchanged from Linnaeus' (1738) *Hortus cliffortianus* account, and with reference to synonyms from Bauhin (1623) and Clusius (1601). In the Clifford herbarium (BM) there are two sheets (labeled Anemone 3) associated with the polynomial from *Hortus cliffortianus*. The first, bearing a typical wild morph, is annotated in part "Ranunculus phragmites albis," and the second, a double-flowered morph, "Ranunculus nemorosus flore albo." Specimen 710.27 (LINN!) is annotated "ex Herb. Cliff." and appears to be a duplicate of the double-flowered morph.

The "Ranunculus phragmites albis" specimen best conforms to Linnaeus' polynomial and belongs to the most widespread form of the species. Peter Sell (in sched.) selected this sheet as his choice of lectotype. We are delighted to publish here his designation of Herb. Clifford '224 *Anemone* 3,' annotated "Ranunculus phragmites albis" (BM!) as the lectotype of *A. dichotoma*.

ANEMONE THALICTROIDES L. AND ITS VAR. *UNIFLORA* PURSH

Linnaeus (1753: 542) proposed an unnamed variety β under *Anemone thalictroides*, citing a polynomial proposed by Gronovius (1739: 62) in *Flora virginica: Thalictrum caule unifloro, ex eodem puncto foliis quatuor simplicibus instructo*. The name was based on *Clayton 294* (BM!), a specimen that Linnaeus probably examined in the winter of 1737. Pursh (1814: 387) later cited the same polynomial and formally named it var. *uniflora*. There is no evidence that Pursh actually saw the Clayton specimen in the British Museum or, for that matter, ever found a specimen of *A. thalictroides* with only a single flower.

When Pursh was preparing the text for his *Flora americanae septentrionalis*, he was in England and had access to the collections in the British Museum and other nearby institutions (Ewan 1979). At Oxford there are many Pursh types, annotated by him as new species or varieties. The same is true of material then in the Banks Herbarium (BM), although the specimens are fewer in number. The Clayton specimen at BM was presumably available to Pursh but he did not annotate it and it is therefore unclear that he actually examined it. We have been unable to locate any specimen elsewhere which Pursh annotated 'var. *uniflora*,' and there is no evidence to indicate that he had any knowledge of this plant other than from the descriptions of Gronovius (1739) and Linnaeus (1753).

Had Linnaeus named the variety, *Clayton 294* would be the lectotype. In the case of Pursh, there is no evidence he saw the sheet, nor that he had access to any other element that might be regarded as "original material" (Art. 7.4). However, the specimen would seem to be the most appropriate neotype. Therefore, *Clayton 294* (BM) is designated here as the neotype of *Anemone thalictroides* L. var. *uniflora* Pursh, *Fl. amer. sept.* 2: 387. 1814.

In our opinion, the name is a taxonomic synonym of *Anemonella thalictroides* (L.) Spach.

As for the typical expression of *Anemone thalictroides*, Britton (1891: 238) lectotypified the name (as "Type of *A. thalictroides* in Herb. Linn."; Greuter et al. 1988; see Art. 8.3) on *Kalm, s.n.* (710.35 LINN!). The only other original element is a Plukenet illustration (1691: t. 106, f. 4) that is essentially a copy of a Banister drawing (Ewan and Ewan 1970). There is a Banister specimen in the Plukenet herbarium (Herb. Sloane 89:64, BM-SL!), but it appears not to have been the basis of the 1691 illustration.

ANEMONE VIRGINIANA L.

When Linnaeus (1753) established *Anemone virginiana*, he provided an extended description based on flowering and fruiting material. In synonymy he cited van Royen (1740), Gronovius (1739) and Hermann (1687, 1698). Gronovius referred to *Clayton 529*, a specimen Linnaeus would have seen. An unattributed, flowering specimen at LINN (710.19!), annotated "11 virginiana" by Linnaeus, may be a duplicate. A fruiting specimen (710.20 LINN!), annotated in Linnaeus' hand "K" (for "Kalm"), was probably available to him in 1753, but, as the sheet was not annotated further, it is not possible to be certain of Linnaeus' view of its identity.

Britton (1891: 223) proposed a lectotypification (as "Type of *A. virginiana* L., in Herb. Linn."; Greuter et al., see Art. 8.3) without designating a specific specimen. However, as sheet 710.19 is the only eligible original material at LINN, it must be considered the lectotype.

ACKNOWLEDGMENTS

We are grateful to Dan H. Nicolson and Peter Sell for their helpful comments. Work on the Linnaean Plant Name Typification Project by JLR and FRB is supported by National Science Foundation Grant BSR-8812816. This is Scientific Article A-1609, Contribution No. 8274, of the Maryland Agricultural Experiment Station and Cooperative Extension Service.

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Bartonia No. 57: 32–35, 1992

A Note on the Repaged Reprint by William Griffith of Jack's "Descriptions of Malayan Plants" (Calcutta, 1843)

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William Jack (1795–1822), a native of Aberdeen, Scotland, became a medical doctor on the establishment of the Honorable East India Company in 1813 and after serving in Nepal was appointed as botanist-surgeon on the staff of Sir Stamford Raffles in the latter's effort to consolidate Company control over a region on the western coast of Sumatra, with headquarters at Bencoolen. During three years' residence there, and with the collections he had made in Penang, Singapore, and elsewhere, Jack accomplished a remarkable progress in elucidating the then poorly known flora. With the encouragement and assistance of Nathaniel Wallich, of the Botanic Gardens in Calcutta, Jack collected, diagnosed, named, and classified many new genera and species of plants. As Merrill has suggested (1952) Jack should be recognized as the pioneer post-Linnaean Malaysian botanist, for his studies antedated those of Carl Blume in Java. Moreover, his published work shows his acute understanding of the critical elements of good phytography; Griffith (1843) says his descriptions are autographs of the plants. He employed the then-innovative "natural system" in a period in which the artificial, numero-sexual Linnaean system was still the norm. However, a double tragedy occurred; Jack succumbed to tuberculosis on Sept. 15, 1822, in Bencoolen; and his herbarium, notes and manuscripts were destroyed in the fire that consumed the "Fame" the vessel on which Raffles and his party had embarked to leave Bencoolen (Feb 2, 1824). This fire destroyed, in addition to Jack's materials, according to Raffles "all my papers . . . notes and observations, with memoirs and collections, sufficient for a full and ample history, not only of Sumatra, but of Borneo and almost every other island of note in these seas; my intended account of the establishment of Singapore, the history of my own administration; eastern grammars, dictionaries and vocabularies; and last, not least, a grand map of Sumatra . . . all my collections in natural history, all my splendid collection of drawings, upwards of two thousand in number, with all the valuable papers and notes of my friends, Arnold and Jack. . . ." From this account (quoted from Burkill 1916) we can appreciate the severity of the loss to science that occurred on that February evening.

Jack had, however, previously sent both specimens and notes to Wallich in Calcutta, so there remains a small number of authentic Jack specimens (some also in Edinburgh; see Cowan 1954). Moreover, Jack submitted manuscripts to Wallich and to others, in England, and as a result there are publications by Jack other than those he had printed at the Sumatran Mission Press in Bencoolen, and some are posthumous. Jack's published works are few, but are exceptionally important for three reasons: first, his perspicuity and crisp descriptive style; second, the early date of his work; and third, the rarity of his publications. The latter reason induced four different reprintings of Jack's work. The first, a series produced by W. J. Hooker, appeared rather inconveniently between 1830 and 1836 in three different journals (Hooker 1830, 1834, 1836). The second was a rearranged series of Jack's new plants published by William Griffith in the Calcutta Journal of Natural History (1843). This was issued separately as a repaged reprint in the same year (1843), but (perhaps inadvertently) included a middle section containing one of Griffith's own papers. Whether because of this or for some other reason, it appears that this reprint was issued only in a very small set, or possibly was suppressed. It is this reprint which is the subject of this note. The third reprinting of Jack's work is found in a four-volume set issued in 1886 and 1887 under the general heading "Trübner's Oriental Series" and with the subtitle "Miscellaneous papers relating to Indo-China (Series 1), amended to . . . "and the Indian Archipelago" (Series 2). The initiation of this series came from the Royal Asiatic Society, Straits Branch. The fourth reprinting is a modern one, and is a photo-facsimile of Jack's original "Descriptions of Malayan Plants I-III" as printed in Bencoolen. This facsimile edition was produced by the Boerhaave Press, Leiden, in 1977 (and reviewed by Stone 1978; also Stafleu, Taxon 27: 111. 1978.).

The bibliographic problems that arise from these four (or counting the Griffith reprint, five) various reprintings of Jack's work are complex, but the purely botanical problems whether essentially taxonomic or primarily nomenclatural were more troublesome. Fortunately, both I. H. Burkill (1916) and E. D. Merrill (1952) have published accounts which have settled at least the majority of these problems. The identification of Jack's new genera discloses the regrettable fact that, because Jack's work (when published) was so inaccessible to contemporary and immediately subsequent botanists, many of his names for plants which he clearly diagnosed were not taken up and, in some cases, later-published names have become legally established in lieu of his names through the operation of the International Code of Botanical Nomenclature (by designation of "nomina conservanda"). Nevertheless, it is now increasingly appreciated that Jack is an important figure in the history of Malesian botany and, as has been said before, would have been, had he lived, almost certainly a major force in mid-nineteenth century botany.

The Griffith Reprinting

William Griffith (himself a botanist and of major importance in Malesian botany) edited the Calcutta Journal of Natural History, and as described above, reprinted Jack's "Descriptions of Malayan Plants" but rearranged them according to their "Natural Families" from Jack's own series, the Malayan miscellanies. The work reprinted from the journal was repaged in one sequence, but included Griffith's own paper "On some remarkable plants in the H. C.[1] Botanic Gardens, Calcutta" (pp. 135–160).

Merrill (1952) comments: "Had this . . . reprint . . . been generally available, probably any further consideration of them would have been unnecessary. But sets of the Calcutta Journal of Natural History are lacking in very many, perhaps most botanical libraries, and the separately page reprint was apparently suppressed; or at any rate it was never widely distributed." Merrill states that he had seen only two copies of the reprint, one in the Linnaean Society of London, one in the Lindley Library of the Royal Horticultural Society of London. Whatever is the true rarity of this work remains to be ascertained, but at least one other copy exists, and is to be found in the Department of Botany of the Academy of Natural Sciences of Philadelphia. This copy has an apparent autograph of Griffith on the cover page (which reads "For the Library of the Philadelphia Academy of Natural Sciences with the Editors respects"). The copy is unbound,

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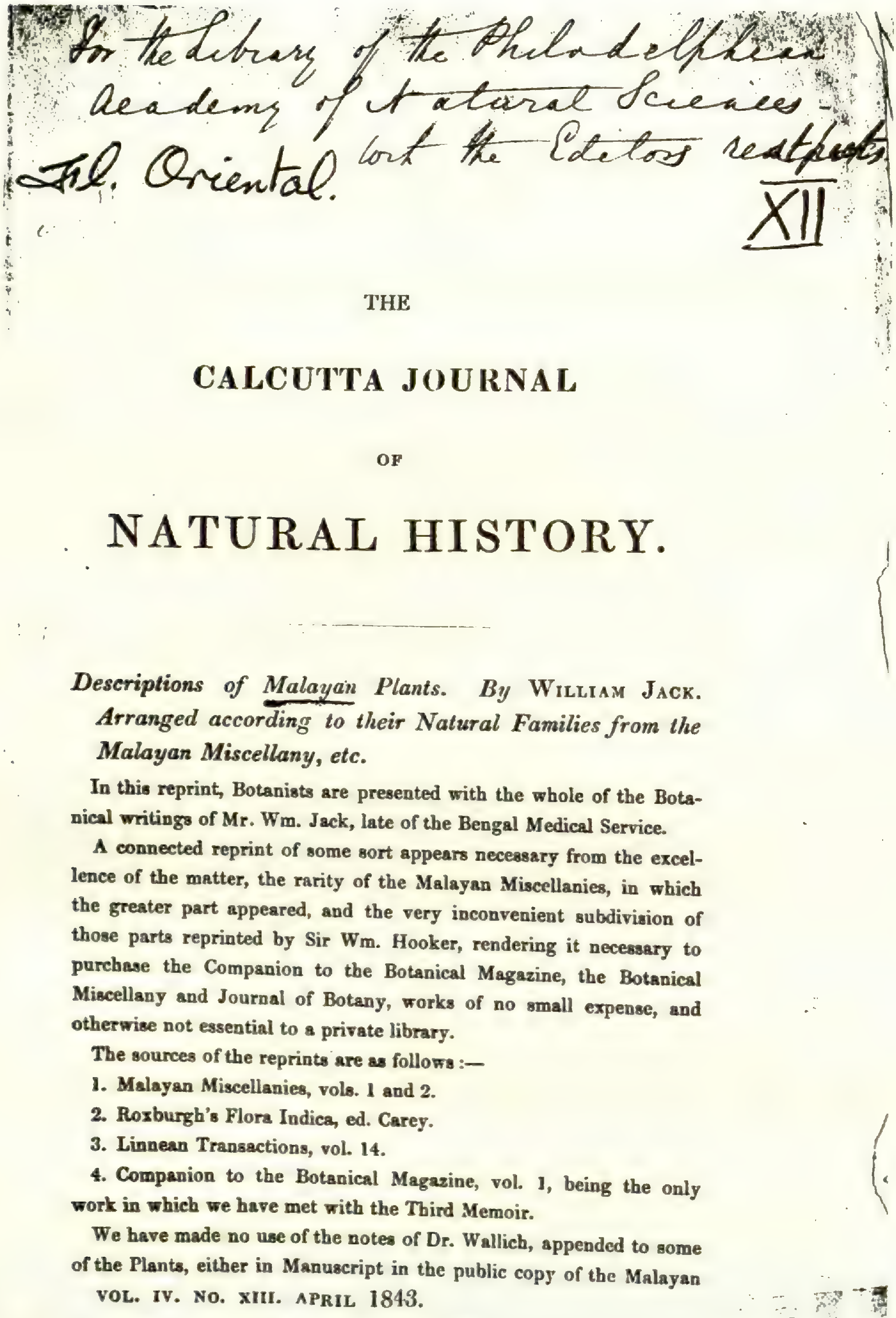
[1] The initials H. C. stand for "Honourable Company(s)" in reference to the East India Company.



For the Library of the Philadelphia
Academy of Natural Sciences –
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THE

CALCUTTA JOURNAL

OF

NATURAL HISTORY.

Descriptions of Malayan Plants. By William Jack. *Arranged according to their Natural Families from the Malayan Miscellany, etc.*

In this reprint, Botanists are presented with the whole of the Botanical writings of Mr. Wm. Jack, late of the Bengal Medical Service.

A connected reprint of some sort appears necessary from the excellence of the matter, the rarity of the Malayan Miscellanies, in which the greater part appeared, and the very inconvenient subdivision of those parts reprinted by Sir Wm. Hooker, rendering it necessary to purchase the Companion to the Botanical Magazine, the Botanical Miscellany and Journal of Botany, works of no small expense, and otherwise not essential to a private library.

The sources of the reprints are as follows :—

1. Malayan Miscellanies, vols. 1 and 2.
2. Roxburgh's Flora Indica, ed. Carey.
3. Linnean Transactions, vol. 14.
4. Companion to the Botanical Magazine, vol. 1, being the only work in which we have met with the Third Memoir.

We have made no use of the notes of Dr. Wallich, appended to some of the Plants, either in Manuscript in the public copy of the Malayan

VOL. IV. NO. XIII. APRIL 1843.

FIG. 1. First page of the reprint from the Calcutta Journal of Natural History, repaged by Griffith. The dedication to the Academy is presumably in Griffith's hand.

is paged 1–230 and includes 3 blank leaves at the end. As is true for the copies Merrill saw, the Figures (indicated by captions on pp. 228–230) are lacking, as is the Index. Otherwise the copy seems complete. The paper (particularly pp. 1–78) is slightly yellowed and somewhat brittle. There is no half-title. On the first page the date and volume reference is printed (Vol. IV. No. XIII. April 1843). A copy of the first paper is given here (FIG. 1).

ACKNOWLEDGEMENTS

I thank Dan Nicolson (Smithsonian Institution) and Ernie Schuyler (Academy of Natural Sciences) for their assistance.

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Bartonia No. 57: 36–38, 1992

Matelea suberosa (L.) Shinners (Asclepiadaceae)—Once Again

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New provisions in Article 8 of the *International Code of Botanical Nomenclature* (Greuter et al. 1988) have defined more explicitly the conditions whereby a valid lecto- or neotypification can be established. Article 8.3 states that "designation of a type is achieved only if the type is definitely accepted as such by the typifying author, and if the type element is clearly indicated by direct citation including the term 'type' or an equivalent."

For Linnaean names the designation of types is especially critical. Considering what Linnaeus was attempting to do in 1753—that is, summarize the world's known flora—it is not too difficult to understand that he occasionally circumscribed a taxon so as to include more than what today is considered a single entity. Furthermore, not all of the specimens and drawings comprising the original material for a given name were in his possession in 1751–1752 when he was completing the final draft of *Species plantarum*. Many elements, particularly specimens, which influenced circumscriptions published in his previous works had not been seen by him for over a decade.

In the case of *Cynanchum suberosum*, Linnaeus (1753: 212) cited a variety of elements, few of which were actually before him as he composed the text. The specimens he had seen in Holland which were the basis for his phrase name *Cynanchum caule volubili perenni, inferne suberoso fisso, foliis cordatis acuminatis* in *Hortus cliffortianus* (Linnaeus 1738: 79), as well as the slightly altered versions of the same name in Gronovius' (1739: 27) *Flora virginica* and in van Royen's (1740: 409) *Flora leydensis prodromus*, were not available for him to review in 1751. He did have the illustration drawn by Dillenius in *Hortus elthamensis* (1732: 308, t. 229, f. 296), and he had at least one herbarium specimen, 308.5 (LINN!), a garden specimen grown at Uppsala that Linnaeus annotated "suberosum 2 HU." A second specimen, 308.13 (LINN!), collected by John Clayton, probably *Clayton 637* (duplicate at BM!), may have been in his possession as well. As Linnaeus failed to annotate the Clayton sheet, there is no way of knowing today what he regarded its identity to be, and this sheet cannot be considered original material.

The identity of the various elements cited by Linnaeus has never been fully resolved. No van Royen material is known to exist. The Herb. Clifford specimen (79, *Cynanchum* 5, BM!), is a sterile portion of a branch of an as yet unidentified member of Asclepiadaceae, possibly a species of *Cynanchum*. The Clayton specimen cited by Gronovius (*Clayton 1 et 233* (BM!)) is what is known today as *Matelea carolinensis* (Jacq.) Woodson, as is 308.5 (LINN). *Clayton 637* is a collection of *M. gonocarpa* (Walter) Shinners. Linnaeus appears to have defined *Cynanchum suberosum* to include what are accepted today as at least three different species.

When Asa Gray reviewed Linnaean specimens in the late 1860s, he examined all of the available material associated with *Cynanchum suberosum* and concluded that "we may consider the Linnaean species as founded on the Dillenian plant, the figure of which very well represents what one takes for this species" (Gray 1876: 75). The expression "founded on" may be regarded in many instances as equivalent to "type" (Greuter et al. 1988; see Art. 8.3) and had Gray alluded to an original element he would have effectively lectotypified the name. Unfortunately, Gray considered the specimen at Oxford to be the element upon which Linnaeus based the name, not the Dillenian figure. As there is no evidence that Linnaeus ever examined the specimen, it can not be considered original material. Consequently, Gray's statement can not be accepted as an effective lectotypification. However, the statement indicates that Gray applied the name in the sense of the Dillenius figure. In order to maintain this usage, *Cynanchum suberosum* is lectotypified here on Dillenius, *Hortus elthamensis*, t. 229, f. 296.

In her review of the genus *Gonolobus* in the range of Gray's *Manual*, Parry (1939) concluded that there were two species characterized by having abaxially glabrous calyx lobes and smooth follicles. These were *G. gonocarpos* (Walter) Perry and *G. suberosus* (L.) R. Brown. The two differed mainly in the ratio of corolla lobe to calyx lobe, with *G. gonocarpos* having a corolla lobe more than twice the length of the calyx, whereas that of *G. suberosus* was less than twice as long. Also, the flowers of the first species were mainly yellow whereas those of the second were mainly maroon with greenish tips. The hand-painted illustration in the copy of *Hortus elthamensis* in the library of The Natural History Museum, London (FIG. 1), depicts the flowers as maroon with greenish tips; the plate also shows petals about twice the length of the calyx lobes.

Nomenclaturally, therefore, *Matelea suberosa* is the earliest available name for the southeastern United States plant known as either *Gonolobus suberosus* (L.) R. Brown in Aiton or *Vincetoxicum suberosum* (L.) Britton. Should it be regarded as taxonom-

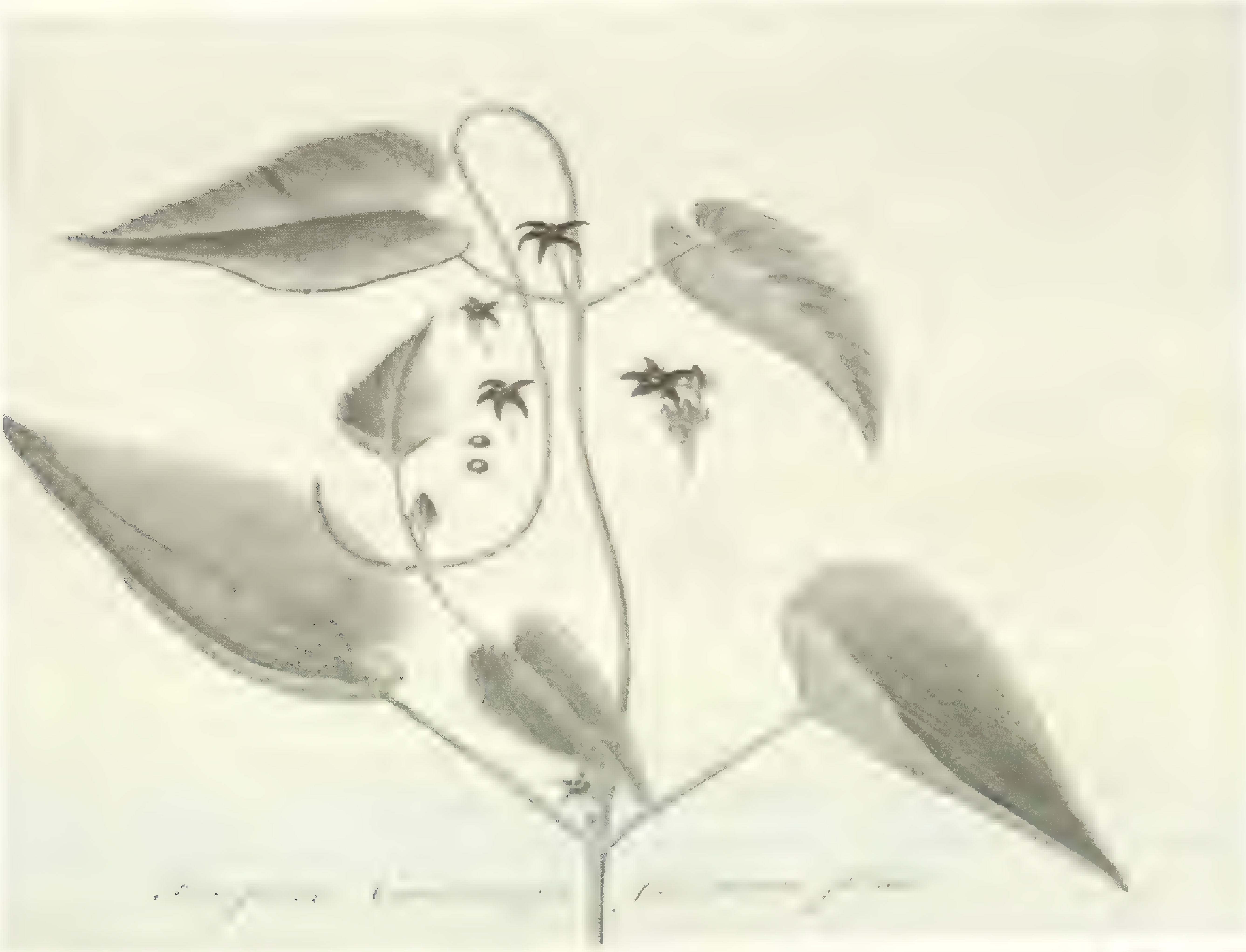

FIG. 1. Lectotype of *Cynanchum suberosum* L., Dillenius, *Hortus elthamensis*, t. 229, f. 296.

ically the same as *M. gonocarpa,* based on *V. gonocarpos* Walter, then *M. suberosa* has priority. We leave the question of the distinctiveness of the two species for others to resolve.

ACKNOWLEDGMENT

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Bartonia No. 57: 39–49, 1992

A New Status for New Jersey's Yellow Spring Beauty

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Claytonia virginica L. var. **hammondiae** (Kalmbacher) Doyle, Lewis, and Snyder, comb. et stat. nov.—*Claytonia virginica* L. forma *hammondiae* Kalmbacher, Torreya 97: 123. 1970. TYPE: New Jersey: Sussex County: ±10 miles west of Culver's Lake, south side Kittatiny [sic] Mts. west of Culver's Lake, 15 May 1967, E. K. Hammond s.n. (type and isotype BK!; isotypes GH!). DISTRIBUTION: Confirmed only from the type locality, FIG. 1.

ADDITIONAL SPECIMENS EXAMINED. NEW JERSEY: Sussex Co.: ca. 8 km SW of Culver's Lake: In open shade along small stream and on raised tussocks of *Carex bromoides* that are surrounded by shallow water, 28 Apr 1985, *D. B. Snyder 10-2* (DBS = pers. herb. David B. Snyder) and *10-3RU* (CHRB); Open seepage meadow dominated by *Deschampsia cespitosa*, 4 May 1985, *D. B. Snyder 10-4* (DBS), *10-5PH* (PH), and *10-6NY* (NY); Seepage areas adjacent to small stream, growing in shade under canopy of *Tsuga canadensis, Pinus strobus, Acer rubrum, Betula alleghaniensis*, and *Rhododendron maximum*, 18 May 1985, *D. B. Snyder 10-7* (DBS) and *10-8PH* (PH), also 9 May 1986, *D. B. Snyder 10-12, 10-13*, (DBS), *10-15RU* (CHRB), *10-14PH* (PH), 26 May 1988, *D. B. Snyder 10-16, 10-17* (DBS), *10-18GH* (GH), and 26 Apr 1991, *10-27* (DBS); Growing in *Sphagnum* at edge of sloping seepage meadow, 13 Jun 1985, *D. B. Snyder 10-9* (DBS) and *10-10RU* (CHRB); A saturated bryophyte and sedge dominated floating turf skin formed over spring head, partial sun, 24 Aug 1985, *D. B. Snyder 10-11* (DBS), also 11 Jul 1990, *D. B. Snyder 10-21, 10-22, 10-25, 10-26* (DBS), *10-19BK* (BK), *10-23RU* (CHRB), *10-20NY* (NY), *10-24PH* (PH); Wet seepage areas and streambanks in hemlock-hardwood-white pine woods, ca. 300 m, 3 May 1986, *A. Cronquist, D. Snyder*, and *L. A. Caruso 11999* (GH, NY).

Claytonia virginica[1] occurs throughout much of eastern North America, from southern Canada south to Georgia, west to Minnesota and Texas (Davis 1966). Its chromosomal and morphological variability has been a source of considerable speculation and taxonomic confusion. Chemosystematic analysis of *C. virginica* over the last 30 years has begun to unravel its complexities. Doyle (1981, 1983, 1984a) recognizes *C. virginica* as a complex of four distinct chemical races which are "almost certainly a complex of at least four distinct species." Since Doyle (1981) found no reliable morphological differences that could accurately identify the four races, he concluded that "little benefit would be achieved by realigning the existing nomenclature to reflect the postulated evolutionary trends in the complex." Given its morphological and chemical variability, any nomenclatural changes within the *C. virginica* complex necessitates extreme caution.

In the Ridge and Valley Province in northwestern New Jersey, located several kilometers southwest of Culver's Lake, Sussex County, there is an extensive population of a yellow flowered *Claytonia*. An estimated few thousand plants occur scattered over approximately 6 hectares of spring-fed acidic wetlands on the lower, southeast facing slope of the Kittatinny Mountains at an elevation between 305 and 335 meters. Morphologically they are indistinguishable from *Claytonia virginica*, except for petal and anther color. Typical plants of the *C. virginica* complex which have pink to white petals

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[1] Nomenclature follows Kartesz and Kartesz (1980) unless otherwise noted.

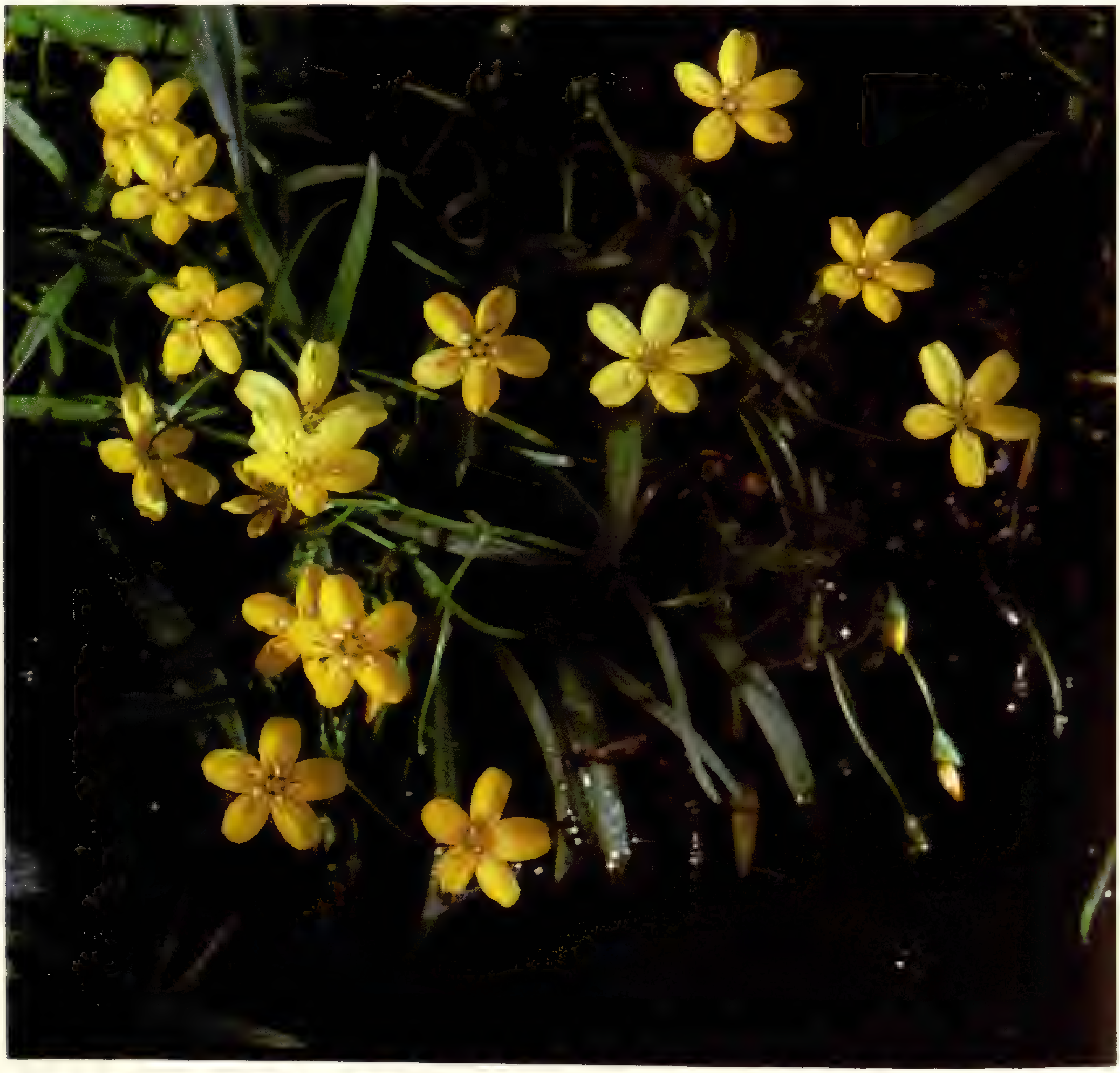

FIG. 1. *Claytonia virginica* var. *hammondiae*. A typical plant showing bright yellow petals (Pantone 109C) with similarly colored veins and white anthers. Growing on *Carex bromoides* tussocks in shallow water.

with pink veins and pink anthers (Davis 1966) are common throughout much of New Jersey's Inner Coastal Plain, Piedmont, and parts of the Highlands, but are infrequent to rare on the Outer Coastal Plain and Ridge and Valley Provinces. No typical *C. virginica* occurs within the yellow flowered population. The nearest extant population of typical *C. virginica* that I have observed is at Springdale, Sussex County, approximately 18 kilometers to the south.

The intensity of the yellow color of the petals is striking, ranging from a deep yellow (comparable in color to the flowers of *Ranunculus septentrionalis* with which it occurs) to yellow-orange. The petal color of most plants fall within Pantone 109C, 116C, and 123C of the Pantone Color Formula Guide. Petal veins of most plants are yellow, and barely, if at all, contrast with the background color of the petals. Scattered here and there within the population are plants with petals having orange to red-orange veins, which viewed from a short distance, gives an overall orange cast to the petals. On all plants, the anthers are white in color, as is fresh pollen, and the stamens are yellow.

Yellow flowered plants of the *C. virginica* complex have been reported from other northeastern states. Ball (1915) reported orange flowered plants growing in abundance in a meadow near Quakertown, Pennsylvania "that appeared normal in every way excepting in the color of the flowers." Davis (1966) described a yellow color form of *C. virginica* based on specimens collected in Maryland (Maryland: Sesquehana [sic] Canal, 3 may 1957, *G. A. Elbert* s.n., GH!). Davis named this plant forma *lutea* and noted that "Aside from the petal color, I could see no essential difference in other parts of the plant from the usual *C. virginica*." In correspondence attached to the type specimen the collector reported that "there were about a dozen plants in the area, surrounded by the standard white to pink *Claytonia virginica*" and that the color slides "do not show clearly the characteristic bright pink veins on the petals or the pink stamens [including anthers?]." No detailed description of the habitat is given aside from "an especially rich area . . . along the Susquahanna Canal." Wherry (1974) and Wherry et al. (1977) reported three locations for *C. virginica* forma *lutea* in southeastern Pennsylvania: Quakertown (discussed above) and Churchville, Bucks County, and Westtown, Chester County. Specimens collected from these localities have been examined at PH. Color slides of plants from the Westtown population clearly show the pink anthers and pink venation of the petals. The Churchville population was recently relocated by Ann Rhoads. Yellow flowered plants are abundant in one area at this site, and are mixed with white flowered plants. A complete gradation between the two colors exists, with the yellow forms most closely matching Pantone 113U, 114U, 120U, and 127U. Both yellow and white flowered plants had pink anthers and petals with pink veins. The population is growing in moist soil on a wooded, gentle slope of a small floodplain. The canopy is dominated by *Acer rubrum* and *Liriodendron tulipifera* with an open shrub layer of mostly *Lindera benzoin*. Conspicuous herbs include *Arisaema triphyllum, Allium vineale, Ranunculus abortivus, Alliaria petiolata, Geum lanciniatum, Phlox divaricata,* and *Aster divaricatus*. A second Maryland site (Cecil County) recently has been found that has yellow flowered *C. virginica*. Arthur Tucker (pers. comm.) describes the petals as being more orange than yellow with reddish veins and pale pink or orange anthers and growing with typical white flowered *C. virginica*.

Aside from the petal color of the plants found in the Churchville, Pennsylvania, population, I see no indication that these yellow flowered plants are any more than a color form. Available information on the remaining Pennsylvania collections, and the two Maryland populations also suggests color forms. Davis' *C. virginica* forma *lutea* seems an appropriate name for these plants.

Flavonoid (Jeff Doyle pers. comm.) and cytological data ($2n = 44$, Walter Lewis pers. comm.) indicates that *C. virginica* var. *hammondiae* is most closely related to a broad-leaved midwest and New York City area wholly polyploid race which has been treated taxonomically as *C. robusta* Rydb. and *C. virginica* L. forma *robusta* (Somes) Palmer and Steyermark, and is included within Doyle's (1981) Race IV. Although plants of Race IV (i.e. *"C. robusta")* have been described as being generally larger plants with cauline leaf widths up to 25 mm (Fernald 1950; Gleason 1952; Davis 1966), much variation in leaf width occurs, and this character alone is not diagnostically conclusive (Doyle 1984b). Leaf width of *C. virginica* var. *hammondiae* is variable and cauline leaf widths ranged between 1 mm and 14 mm. Some of this variability may be possibly an ecologically induced response. Plants growing in extremely wet soil in deep shade under a predominantly evergreen canopy were generally broad-leaved, while those growing in full or partial sunlight in sedge and grass dominated seepage wetlands were consistently narrow-leaved. Possible cytological differences between broad-leaved and narrow-leaved plants have not been investigated.

Claytonia virginica var. *hammondiae* is restricted to an extensive wetland complex underlain by a clay fragipan. The numerous springs that originate both onsite and from farther upslope, provide a fairly constant supply of water throughout the year. Where the plants occur, soil conditions range from extremely moist to saturated. During the spring months, plants are frequently inundated by the overflowing of brooks and the upwelling and pooling of water in seepage areas and plants of some subpopulations often flower, set seed, and senesce in, or surrounded by, standing water. *Claytonia virginica* var. *hammondiae* occurs in both forested and open wetland communities. The forested sites are characterized by a canopy dominated by *Tsuga canadensis, Pinus strobus, Betula alleghaniensis,* and *Acer rubrum.* In places the shrub layer is a dense tangle of *Rhododendron maximum* with a scattering of *Lindera benzoin* and *Hamamelis virginiana.* Herbs associated with *C. virginica* var. *hammondiae* at one of these forested sites include *Equisetum arvense, Osmunda cinnamomea, Onoclea sensibilis, Athyrium filix-femina, Glyceria melicaria, Carex leptalea, C. prasina, C. scabrata, Symplocarpus foetidus, Listera cordata, Maianthemum canadense, Veratrum viride, Coptis trifolius, Ranunculus septentrionalis, Cardamine bulbosa, Polygala paucifolia, Chrysosplenium americanum, Saxifraga pensylvanica, Viola cucullata* Ait., *Panax trifolius, Trientalis borealis,* and *Senecio aureus.* Soil pH at this site was measured at 3.5. The open wetlands are less diverse, with *Deschampsia cespitosa, Carex bromoides,* and *C. atlantica* var. *incomperta* the obvious dominants. *Osmunda cinnamomea, Symplocarpus foetidus, Maianthemum canadense, Viola cucullata, Kalmia angustifolia, Coptis trifolius,* and *Solidago puberula* are scattered to isolated.[2] The pH of these communities ranged from 4.5 to 4.7. There is some evidence of past human disturbance in or adjacent to both of these open communities. Species of *Sphagnum* occur in both forested and open sites, but are most abundant in the grass and sedge dominated communities. *Claytonia virginica* var. *hammondiae* occasionally is found growing in pockets and on hummocks of *Sphagnum,* particularly at the more open sites.[3]

Regional manuals describe general habitat for *C. virginica* as "rich woods, thickets and clearings" (Fernald 1950) and "damp woods and fields" (Gleason 1952; Gleason and Cronquist 1963). Doyle (1984a) describes both *C. caroliniana* (the only other *Claytonia* species occurring in eastern North America) and *C. virginica* as "woodland spring ephemerals, typically of mesic woodlands." *Claytonia virginica* is found in similar habitats in New Jersey, but it reaches its greatest abundance in open, deciduous flood plain woods, especially in the Raritan River drainage. Of the two races in the *C. virginica* complex known to occur in New Jersey (Doyle 1981, 1983, 1984a, 1984b), only the polyploid Race IV has been documented as occurring in wetland habitats (Doyle 1981). Although typical habitat in the Midwest for Race IV is described as disturbed second growth woodlands, this race is characterized as being a "very weedy group" that "colonizes lawns and fields" and also occurs in "low wet areas which are periodically flooded, in drier oak woods, as well in the typical deciduous woodland habitats" (Doyle 1981). In general, it is the polyploids of the *C. virginica* complex that show greatest ecological amplitude, and more southern polyploid races occur in "swamps, often in areas which are at least partially flooded throughout much of the winter" and "even occurring in palmetto swamps in Georgia" (Doyle 1981). While wetlands are not novel habitats in the *C. virginica* complex, they appear to be atypical, at least in the northeastern portion the range.

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[2] *Cerastium biebersteinii* DC., an European introduction (Tutin et al. 1964), is abundant in these open wetlands. It also occurs to a lesser degree in the forested wetlands, as well as in drier, disturbed areas. It is prolific and an aggressive colonizer and is rapidly filling available habitat. At CHRB and NY there are specimens of this species collected by K. K. Mackenzie in 1921 at a site about 1.5 kilometers NE of the yellow *Claytonia* site.

[3] The following *Sphagnum* species are associated with *C. virginica* var. *hammondiae: S. affine* Ren. and Card., *S. bartlettianum* Warnst., *S. henryense* Warnst., *S. palustre* L., and *S. recurvum* P. Beuv. (Eric Karlin pers. comm.).

Claytonia virginica is generally regarded as a spring ephemeral (Lewis 1976; Doyle 1981; Doyle 1984a; Voss 1985). Fernald (1950) reports flowering as occurring between March and May in the northeastern portion of its range. This agrees with herbaria collections and my observations of the species' flowering phenology in New Jersey. The species begins to flower in mid March (rarely earlier) and continues into late May. Flowering throughout the state occurs over a period of approximately 10 weeks, but individual plants typically flower and disperse seeds within a period of about 30 days (Doyle 1981). In the Piedmont of central New Jersey the species reaches its peak flowering in mid to late April. By late May and early June the above ground portion of most plants have either turned yellow or died back. *Claytonia virginica* var. *hammondiae* begins to flower about the fourth week of April. Peak flowering occurs in mid May and continues into early June. By mid June, the majority of plants are senescing, and by the end of June most mature plants have died back. At an especially wet portion of one of the open grass and sedge dominated communities (a floating skin of turf formed over the head of spring and dominated by bryophyte and sedge species), plants continue to flower until late summer. In 1985 plants were in flower and in bud on 24 August. Additional late flowering dates (but not necessarily the last flowering date for the season) recorded are 29 July 1986, 11 August 1987, 14 August 1988, 10 August 1989, and 30 July 1990 (Rick Radis pers. comm.). Thus flowering is extended at least an additional 6 weeks beyond the 10 week statewide average for *C. virginica* in New Jersey. Other spring herbs growing with *C. virginica* var. *hammondiae* bloom perhaps as much as 10 days later here than they do in the Piedmont of central New Jersey where *C. virginica* seems to be most abundant. Since the initiation of growth and flowering may be temperature dependant (Schemske 1977; Doyle 1981) it is possible that differing temperatures may be responsible for the delayed flowering of var. *hammondiae* (i.e. late April for var. *hammondiae* versus late March for *C. virginica* elsewhere in the state). But what accounts for the prolongation of flowering of this taxon? Flowering plants in this subpopulation are on average smaller, with much more narrow leaves, and have fewer flowers per inflorescence then do plants in most other populations (FIG. 2). On 11 July 1990 seedlings and young plants that had a single leaf and a corm under 4 mm were observed and collected (from both this subpopulation and others). Davis (1966) reported that greenhouse sown seeds of *C. virginica* that germinated in February, had flowered by mid May of the same year.[4] It is therefore possible that some of the late flowering plants of var. *hammondiae* have germinated and matured within a single

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[4] Eleven seeds collected 11 July 1990 were sent to William B. Brumback at the New England Wildflower Society (Framingham, MA) for germination. Seeds were sown on 21 July 1990 outside, under natural conditions. By 5 April 1991, 3 seeds had germinated, and by 24 May 1991, a total of seven seeds germinated.

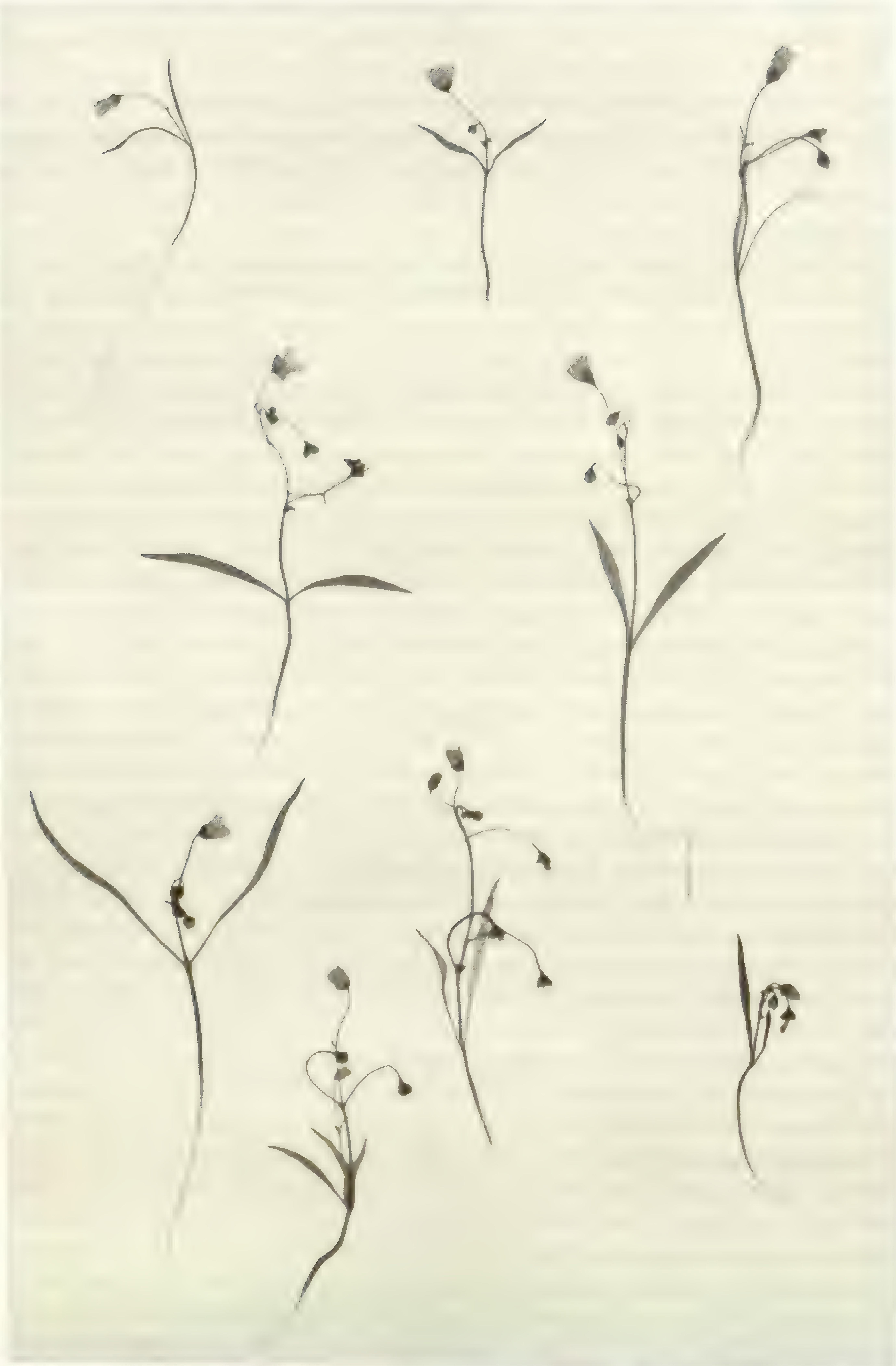

FIG. 2. *Claytonia virginica* var. *hammondiae* collected from a floating turf mat dominated by bryophyte and sedge species showing the narrow leaves (1–4.5 mm) and generally fewer flowered inflorescences characteristic of this subpopulation. Flowering continues at this site until late August.

growing season. However, late flowering plants that clearly are older than one season also have been observed, and flowering plants that I collected in early May of 1985 and planted in a home garden, retained green leaves into mid October. According to Doyle (1981) different cytotypes of the *C. virginica* complex may have different physiological tolerances which have enabled them to colonize different habitats. Under greenhouse conditions he observed that "Race II and Race IV polyploids in many cases do not become dormant . . . producing new leaves and flowering throughout the year." This situation within natural populations is extremely unusual, and has not been previously reported for members of the *C. virginica* complex. For a discussion of how the temporal adaptions of different cytotypes may relate to the evolution of the *C. virginica* complex see Lewis (1976) and Lewis and Suda (1976).

Based on ribosomal DNA analysis Doyle (1988) reports that *C. virginica* var. *hammondiae* is likely of allopolyploid origin, having arisen by the hybridization of *C. caroliniana* and *C. virginiana*. How long ago this hybridization might have taken place is not known, but presumably it was not a very recent event, since the putative parents do not now occur anywhere near *C. virginica* var. *hammondiae*. *Claytonia caroliniana* and *C. virginica* are restricted to eastern North America and although they are parapatric in the northeastern portion of their ranges, they are generally ecologically or altitudinally separated (Uttal 1964; Davis 1966; Voss 1968; Doyle 1981; Doyle 1988). *Claytonia caroliniana* is more northern in its distribution and occurs from Newfoundland and southern Canada, west to Minnesota, south through New England, New York and at higher elevations in the Appalachian Mountains to northern Georgia (Davis 1966). It is not known to occur in New Jersey and the nearest populations are located in adjacent northeastern Pennsylvania (Wherry et al. 1977). As previously noted, the nearest known extant population of typical *C. virginiana* is about 18 kilometers south of *C. virginica* var. *hammondiae*. *Claytonia caroliniana* and *C. virginica* are morphologically very similar, and are best distinguished by differences in leaf shape and leaf width ratios (Davis 1966; Voss 1968; Reznicek and Britton 1971; Doyle 1988). As reported by Uttal (1964), suspected by Voss (1968), and documented by Doyle (1988), *C. caroliniana* and *C. virginiana* do hybridize, and where populations of the two species come into contact, plants with intermediate leaf morphology occur. Leaf shape and width ratios of *C. virginica* var. *hammondiae* are within the expected variability of the *C. virginica* complex. Leaf shape ranges from nearly linear to broadly oblanceolate, and is mostly greater than ten times longer than wide. In one exceptional patch (FIG. 3), many plants had leaves that were under eight times as long as wide, and a few plants had leaves that were less than five times as long as wide, which is well within the range of *C. caroliniana* (Gleason 1952; Davis 1966; Voss 1968). But in all these plants, the leaves lacked definite petioles and did not have the characteristic diamond shape reported for *C. caroliniana* (Voss 1968).

With a very few exceptions, *C. virginica* var. *hammondiae* more closely resembles *C. virginica* in gross morphology than it does *C. caroliniana*. It seems plausible then, that if *C. virginica* var. *hammondiae* is of allopolyploid origin, then through subsequent introgression with *C. virginica* it has become a stabilized, and permanent hybrid taxon and has successfully adapted to an unusual ecological niche.

The possible role of infraspecific or interracial hybridization has not been investigated, and other origins may have contributed to the evolution of *C. virginica* var. *hammondiae* (Walter Lewis pers. comm.). Regardless of its origin, *C. virginica* var. *hammondiae* possess an apparently unique combination of morphological, ecological,

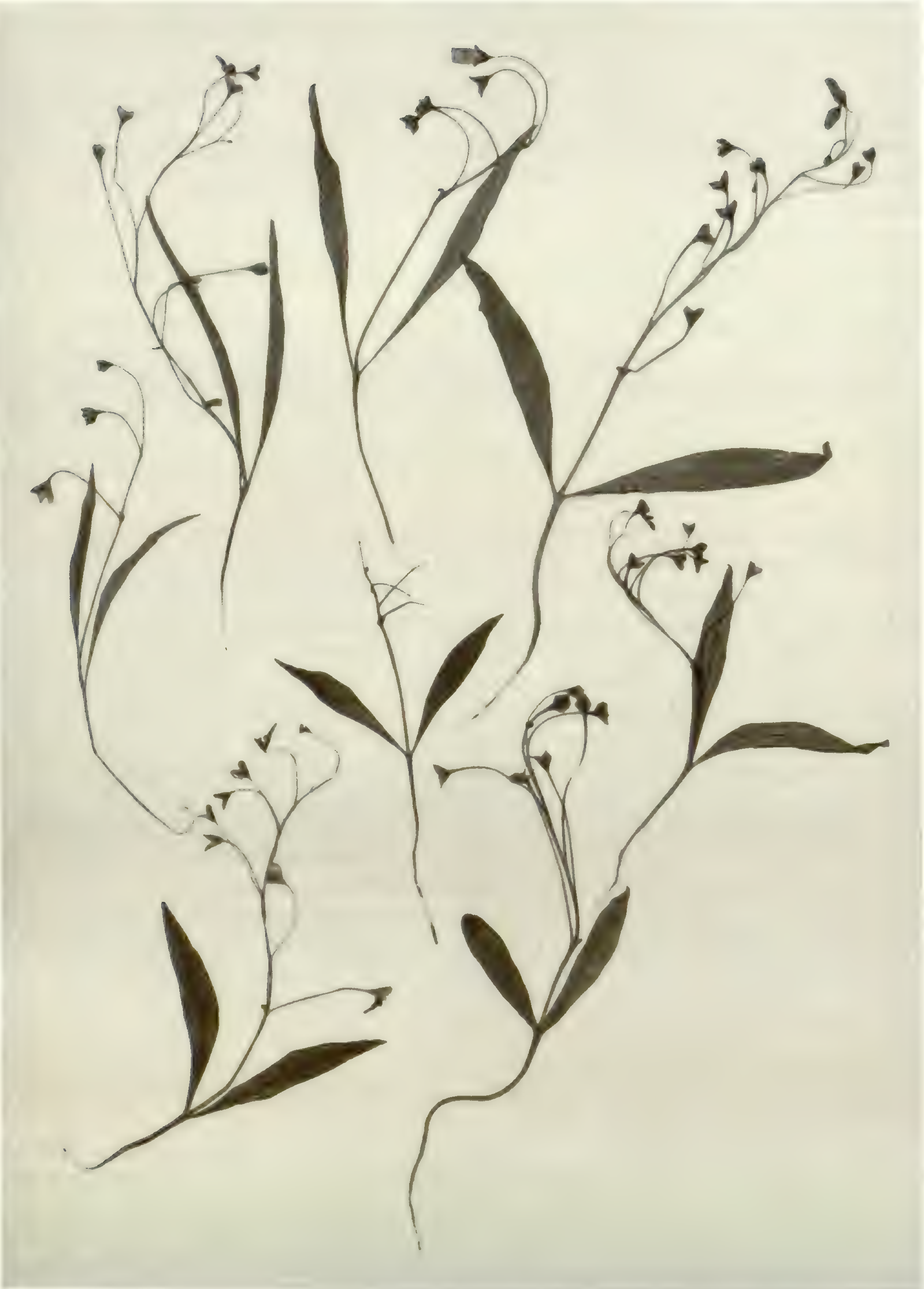

FIG. 3. *Claytonia virginica* var. *hammondiae* collected from a shaded seepage area under *Tsuga canadensis*, *Pinus strobus*, and *Betula alleghaniensis* showing leaf width variation within a single patch. Ratios ranged from 4.3 to 17.0 times longer than wide.

phenological, and chemical characters which support recognition above the rank of forma. As stated by Lewis and Semple (1977), "there is probably sufficient genetic isolation in *C. virginica* to propose that the major ploidy levels and races are already directed into distinct pathways involving morphological and physiological parameters which could lead to speciation."

Only three of the eight *Claytonia* species comprising Section *Claytonia* (McNeill 1975) have varieties or forms that have flowers with petals that are completely yellow (Hitchcock and Cronquist 1964; Davis 1966; Hultén 1967; McNeill 1972)—*C. caroliniana*, C. *lanceolata*, and *C. virginica*.[5] These three species are morphologically similar and differ chiefly in leaf characteristics (Davis 1966). *Claytonia lanceolata* var. *flava* and *C. virginica* var. *hammondiae* are nearly indistinguishable using gross morphological characters, but are geographically isolated and are cytologically distinct *(C. lanceolata* var. *flava* is a diploid with 2n = 16, Davis 1966; Walter Lewis pers. comm.; Steve Shelly pers. comm.). According to Davis (1966) plants of *C. lanceolata* var. *flava* "maintained green leaves the year around where the soil was kept wet, both in the green house and outside. As the old leaves matured and died, new ones grew. This was not true of any other segregates of *C. lanceolata*." Whether this occurs within natural populations, is not known (Steve Shelly pers. comm.). As previously discussed, similar behavior has been documented within Race II and Race IV polyploids of the *C. virginica* complex (including *C. virginica* var. *hammondiae). Claytonia caroliniana, C. lanceolata,* and *C. virginica* are closely allied species and share a similar phylogeny (Lewis et al. 1967) so it is perhaps more than coincidental that these three species all produce yellow flowered taxa.

KEY TO THE YELLOW FLOWERED TAXA OF *CLAYTONIA VIRGINICA*[6]

Anthers white; veins yellow to red-orange; petals deep yellow to yellow-orange; at least some plants blooming into late summer; restricted to wetland habitats .... *Claytonia virginica* var. *hammondiae*

Anthers pink; veins pink; petals pale or deep yellow to orange; plants blooming into late May, rarely later; plants of various habitats, typically meadows and mesic woodlands .... *Claytonia virginica f. lutea*

ACKNOWLEDGMENTS

I am indebted to Jeff Doyle and Walter Lewis for determining and interpreting the cytological, flavonoid, and genetical data, and for their advice and comments offered

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[5] The known examples within the *C. virginica* complex have been discussed. A yellow flowered form of *C. caroliniana* has been only recently reported. Ed Thompson (pers. comm.) discovered a population of *C. caroliniana* in Garrett County, Maryland, which has both typical white to pink flowered plants and yellow flowered plants. Tom Breden (pers. comm.) described the petals of the yellow flowered plants as having a pale yellow cast but otherwise indistinguishable from the white flowered plants. *Claytonia lanceolata* occurs in the western United States and Canada (Davis 1966). The flowers are typically white to pink in color, but in two varieties the petals are yellow. Hitchcock and Cronquist (1964) describe the flowers of var. *chrysantha* as being pale yellow and recognize it at the varietal level (as do McNeill 1975; Kartesz and Kartesz 1980). Davis (1966) considered it "best not to recognize this as a distinct taxon" because "yellow petals [are] the main distinguishing character" and "yellow blotches on the petals are fairly common all over the West." Plants of var. *flava* typically have petals which are golden-yellow (Davis 1966) with petal veins of a similar color (Steve Shelly pers. comm.). Recently discovered are populations containing both white and yellow flowered plants of var. *flava*. According to Steve Shelly (pers. comm.) these two forms "appear to be genetically and morphologically indistinguishable."

[6] Chemical analysis of specimens may be necessary for conclusive identification.

throughout this project. I thank Arthur Cronquist for his many helpful comments and his translation of a Russian reference. David Fairbrothers is thanked for his comments on the chemical data. Tom Breden and Martin Rapp helped in collecting field data and Tom also helped in proofing the ms. Eric Karlin is thanked for his identification of specimens of *Sphagnum*. Frank Dirrigl did the statistical analysis of leaf width data (data not presented here) and also taught me some pretty elegant word processing tricks. The directors/curators at BK, CHRB, GH, NY, and PH are thanked for making specimens available for examination. The Natural Lands Trust is thanked for its prompt action in securing a voluntary protection agreement with one of the major landowners. Patricia Kissinger first brought this unusual spring beauty to my attention. A special appreciation is extended to Katherine and Fred Bufanio for their courtesy, and their continued efforts towards the preservation of *C. virginica* var. *hammondiae*. The following are also thanked for their help with various aspects of this project: Maude Backes, William B. Brumback, Charles Chernati, Tom Hampton, Ronald Hartman, Hollis Marriott, John McNeill, Larry Morse, The Nature Conservancy, The National Park Service, Rick Radis, Ann Rhoads, Ernie Schuyler, Steve Shelly, Ed Thompson, and Art Tucker. Publication costs were paid in part by the New Jersey Field Office of The Nature Conservancy.

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Distribution Patterns of Selected Aquatic and Wetland Vascular Plants in Relation to the Ohio Canal System

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The natural distribution of plants is a result of biotic factors, natural geographical features, climate, and chance dispersal. Natural distributions of plants may be modified intentionally or unintentionally by man and his activities. The actual dispersal of plants by man is often a function of his mode and route of travel. Direct observation of the influence of man in this process is rarely possible. Rather, most available evidence for historical plant migrations must be furnished by correlations between man's activities and deviations from natural or original floristic patterns. Changes in the natural distribution of plants also may be accelerated by the environmental modifications associated with human activities such as railroads (Mühlenbach 1979; Stair 1900) and highways (Catling and McKay 1980; Cusick 1982; Reznicek 1980; Wilcox 1989). The earliest public works project in Ohio which produced major statewide effects on the environment was the building and operation of Ohio's system of navigable canals. Their operation caused significant changes in the distribution of the state's biota which has been documented for fishes (Kirtland 1838, 1846, 1850a, 1850b; Trautman 1957, 1960, 1981) and suggested for molluscs, crayfishes, and other invertebrates (Clark and Wilson 1913; Ortmann 1924). The canals also brought about changes in the geographical distribution of aquatic and wetland vascular plants by breaching natural physical barriers to plant migrations, by creating new types of habitats in certain parts of the state, and by serving as an active vector for plant propagule transport.

The geographical distribution of Ohio's aquatic biota is influenced to a certain extent by the presence of a low natural divide extending east-west across the northern portion of the state (FIG. 1). This divide separates the watersheds of the northern portion of the state that enter the St. Lawrence drainage system via Lake Erie and the watersheds of the southern portion that connect to the Mississippi drainage system by the Ohio River. It has long been recognized that many elements of Ohio's aquatic fauna can be considered indigenous to one or the other drainage systems. The hypothesis that the Ohio and Erie divide is a barrier in the distribution of aquatic and wetland vascular plants has not, to our knowledge, been discussed in the literature. To the contrary, the literature often refers to the ubiquity and widespread distribution of aquatic and wetland plants along with such factors as dispersal by birds and the general uniformity of aquatic and wetland habitats. Geographical studies of terrestrial plants in Ohio have focused on the relationships of plants to physiographic features, types of bedrock and soils, climate, and glacial history (Braun 1961, 1967; Gordon 1969; Forsyth 1971). Because the major

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[1] Professor Emeritus of Botany.

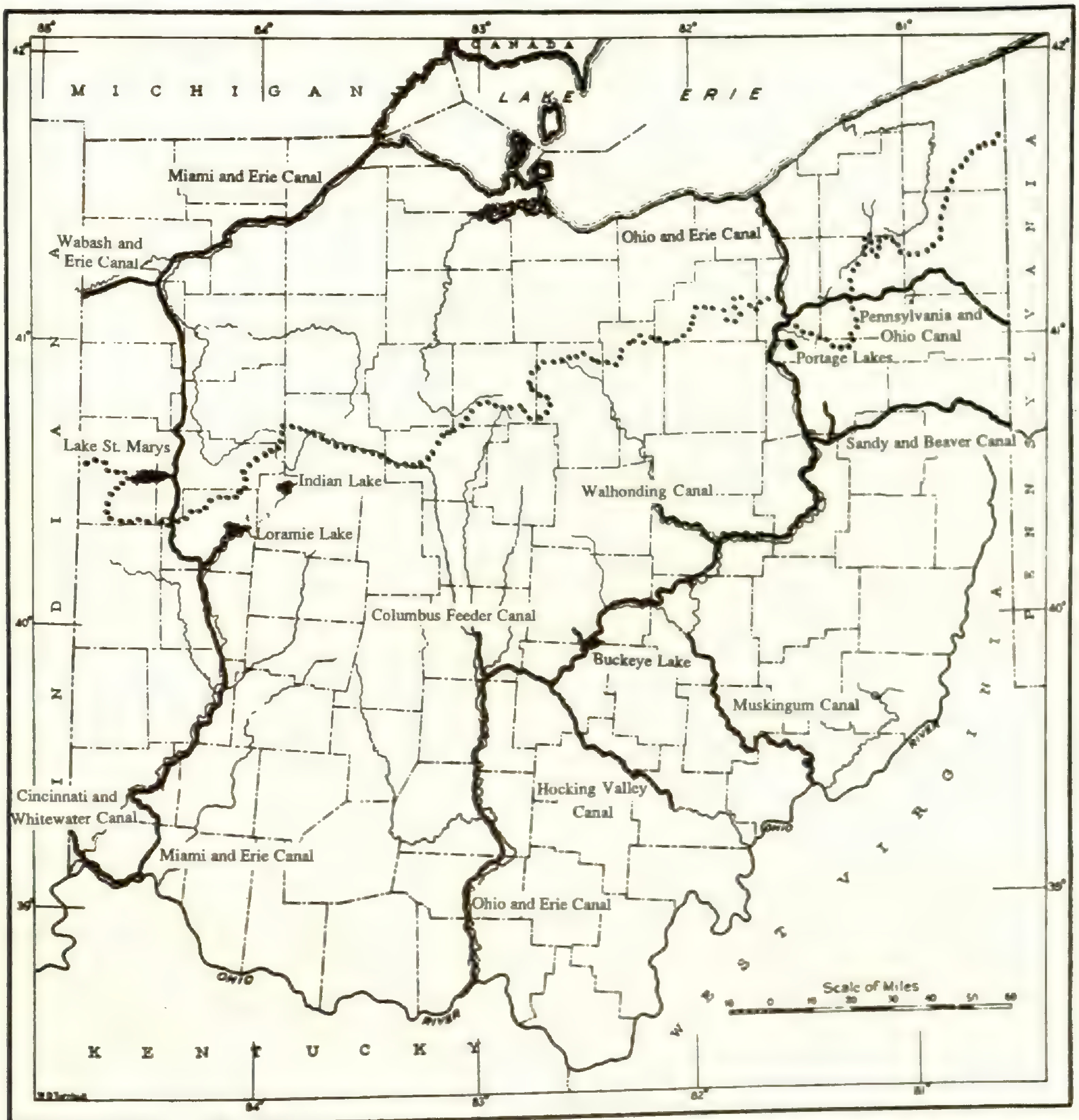

85°
84°
83°
82°
81°
42°
41°
40°
39°
CANADA
MICHIGAN
LAKE ERIE
Miami and Erie Canal
Wabash and Erie Canal
Ohio and Erie Canal
Pennsylvania and Ohio Canal
Portage Lakes
Sandy and Beaver Canal
Walhonding Canal
Lake St. Marys
Indian Lake
Loramie Lake
Columbus Feeder Canal
Buckeye Lake
Muskingum Canal
Hocking Valley Canal
Cincinnati and Whitewater Canal
Miami and Erie Canal
Ohio and Erie Canal
OHIO RIVER
INDIANA
PENNSYLVANIA
WEST VIRGINIA
KENTUCKY
Scale of Miles
10 0 10 20 30 40 50 60

FIG. 1. Map of Ohio locating the major features of the canal systems (solid lines) and the divide between the Mississippi and St. Lawrence drainages (dotted line).

impact of canal construction and travel occurred before any great understanding of Ohio plant distribution accumulated, any changes caused by the canals actually may have obscured natural distribution patterns of some species.

CANALS AS HABITATS FOR THE DISPERSAL AND COLONIZATION OF PLANTS

The Ohio canal system was constructed between 1825 and 1848 (Ohio Legislative Canal Commission 1914; Finn 1942; Wilcox 1969). By 1832 the Ohio and Erie Canal connected the Scioto, Muskingum, and Cuyahoga Rivers (Ohio Board of Canal Commissioners 1833; FIG. 1). From the Ohio River to Lake Erie it ascended and descended 1206 feet by means of 149 locks. In 1846 the Sandy and Beaver Canal and the Pennsylvania and Ohio Canal joined this system to the upper Ohio River (Van Fossan 1946).

By 1845 the Miami and Erie Canal linked the Maumee and Miami River watersheds (FIG. 1). The Wabash and Erie Canal connected southern Indiana waters with the Maumee River in northwestern Ohio in 1841 (George 1927; Newcomer 1937). By 1850, over 1000 miles of navigable canals traversed Ohio, a transportation network that moved agricultural products, manufactured goods, and people throughout the state (Table 1). The importance of the canal system diminished after development of the railroads and then deteriorated in the 1880s. However, the system continued to link Lake Erie with the Ohio River watershed until largely abandoned after flood damage in 1913 (Ohio Legislative Canal Commission 1914; Gilfillan 1959; Wilcox 1969). Today, portions of the canals persist as remnants in public parks, industrial and recreational waterways, and abandoned pools and ditches (Drake 1975). Historic and modern names of major canal system features are listed in Table 1 and mapped in FIG. 1.

Many reservoirs, feeder lakes, and stream diversions supplied water to the canals. At least 29 major dams across natural streams supplemented reservoirs impounding nearly 33,000 acres to provide the 100,000 cubic feet of flow needed for the passage of 100 boats (Gilfillan 1959; Gieck 1988). The canal towpaths traversed the margins of these impoundments, crossed them on dikes or floating bridges, or connected to them by navigable feeders. Among the larger and better known reservoirs, which are still in existence today, were Lake Loramie, Indian Lake (Lewiston Reservoir), and Lake St. Mary's (Grand Reservoir) on the Miami and Erie Canal, and Buckeye Lake (Licking Reservoir) and the Portage Lakes (Summit Reservoir) on the Ohio and Erie Canal. Lake St. Mary's, derived from a natural glacially formed wetland, was the largest man-made body of water in the world at the time of its completion. In northeastern Ohio, the Pennsylvania and Ohio Canal and the Sandy and Beaver Canals were fed by smaller lakes and impoundments, including Congress Lake, Brady Lake, Pepin Lake, Muddy Lake, and Guilford Lake.

The canals were a minimum of forty feet wide and six feet deep, but contracts called for exceeding these dimensions when it was economical. In most stretches, water in the

TABLE 1. Ohio Canals, Principal Feeder Lakes, and Reservoirs (Compiled from: Ohio Board of Canal Commissioners 1833, Ohio Legislative Canal Commission 1914, Gieck 1988, Wilcox 1969).

Canal or Lake	Period of Operation	Length (miles)	Size (acreage)
Miami and Erie Canal	1833–1903	285	
Grand Reservoir (Lake St. Marys)			17603
Loramie Reservoir (Loramie Lake)			1900
Lewiston Reservoir (Indian Lake)			7200
Cincinnati and Whitewater Canal	1839–1863	25	
Wabash and Erie Canal (Ohio portion)	1841–1888	18	
Warren County Extension	1840–1848	17	
Ohio and Erie Canal	1832–1913	309	
Licking Reservoir (Buckeye Lake)			4200
Summit Lake (Portage Lakes)			2000
Columbus Feeder Canal	1841–1865	12	
Hocking Valley Canal	1843–1876	56	
Muskingum Canal and Improvement	1841–1913	91	
Sandy and Beaver Canal (and Nimishillen)	1846–1954	103	
Walhonding Canal	1841–1896	25	
Pennsylvania and Ohio Canal	1840–1872	76	

canals flowed at a rate of several miles per hour away from the major "summits" in the system. Many widenings called "slackwaters" were constructed for the anchorage and turning of canal boats. In hilly areas natural topographic barriers opposite the towpath were used for one bank of the canal and the small valleys and depressions inundated often greatly exceeded the depth and width necessary for navigation. Smaller streams often flowed directly into the canal rather than being diverted by culverts. Sluices draining into adjacent natural waterways prevented dangerous rises in the water levels. The canals crossed over major natural waterways on leaky wooden aqueducts or passed through them behind dams that raised the water level of the stream to the level of the canal. Rivers, lakes, marshes, and canals were intimately connected by a free exchange of water, and potentially, biota.

Historical descriptions and evidence from recent field work suggest that habitats created by the canals were diverse. Substrate, water quality, water temperature, flow rate, and other ecological factors may have varied greatly within various sections of the canal. The canals were often lined with impermeable clays to limit water loss in areas with permeable substrates. Silt and organic material accumulated in other areas and streams diverted into the canals deposited deltas of coarser materials. Some sections of the canal required periodic dredging because of sedimentation and landslides. Although state law limited speed limits on the canal to 4 miles per hour, erosion caused by the wake of barges combined with steep banks and inflowing water may have created considerable turbidity in many stretches of the canal proper. Old photographs suggest that the extensive growth of emersed aquatic plants along the edges of the canal may have significantly decreased such erosion after their establishment. Late summer droughts caused stagnation of the water in some areas. In urban areas the canals were used to dispose of sewage and garbage, as they still are today in some localities (Wilcox 1969). Canal maintenance agreements mandated that banks be cleared of trees for 20 feet to prevent windfalls and snags from clogging the canal.

A canopy of trees on their banks originally shaded all but the larger of Ohio's natural waterways (Trautman 1977, 1981). The shaded portions maintained lower water temperatures compared to open canal habitats. Concomitant with canal construction, extensive clearing of the forest for agriculture raised the temperature in many natural streams (Trautman 1977, 1981). The simultaneous clearing of shaded riverbanks and canal rights-of-way created extensive new open habitats for emersed and submersed vascular plants. Following clearing of the forests, the turbidity of natural streams increased greatly with additional agricultural run-off from adjacent areas. The construction of feeder reservoirs and the modification of existing aquatic and wetland habitats further provided new plant habitats distinct from those already available in Ohio's natural glacial lakes. Extensive areas of marshes and wet woodlands were flooded by shallow water suitable for aquatic plant colonization. Open lake shores exposed by the clearing of trees and extensive mudflats created by late summer drawdowns formed new habitats previously unavailable in many parts of the state. The mosaic of new habitats provided continuous opportunities for the establishment of vegetative and sexual propagules transported across former natural physical barriers in cargo transported inland from the Ohio River or Lake Erie.

Evidence for the Spread of Animals and Plants in Canals

Observations of the role of canals in the changing biogeographic patterns in Ohio were made by several early Ohio naturalists, particularly Jared P. Kirtland, who was probably the first to propose that the distribution of certain fishes and molluscs were changed as a result of the canals. Kirtland first mentioned the anomalous presence of various animals in canals in the Geological Survey of Ohio (Kirtland 1838). Later in a series of technical articles published in the *Boston Journal of Natural History* between 1841–1847 (see references in Trautman 1981) and a series of semi-popular articles in *The Family Visitor* during 1850–1851 (see references in Trautman 1957, 1981), Kirtland indicated that he was familiar with the natural distribution of aquatic organisms and followed changes in their distribution and abundance. He recognized that some species of fishes restricted to the waters of Lake Erie and its tributaries were migrating southward via the canals, whereas others of the Ohio River drainage system were moving northward in canals. About the gizzardshad, *Dorosoma cepdianum* (LeSeur), Kirtland (1850a) wrote: "It has become evident that the species has found its way into the Lake either through the Dayton and Maumee or the main Ohio [and Erie] canals, probably thro' the former, . . . The history of its emigration will herhaps [sic] soon be forgotten, ..." Kirtland (1850b) later reported additional observations on this species, indicating that he was actively attempting to document distributional changes. Although Trautman (1957, 1981) believed the gizzard shad was probably present in Lake Erie before the presence of canals, he did support the general hypotheses first presented by Kirtland that other species had extended their ranges via the canals (Trautman 1957, 1960, 1981). The introduction of fish species into Lake Erie by way of New York's Erie Canal and the Welland Canal has been summarized by Aron and Smith (1971), Smith (1972), and Trautman (1960).

Molluscs, crayfishes, and other aquatic invertebrates also may have migrated by canal. Sterki (1907) and Ortmann (1913, 1924) have related the anomalous distribution of naiades in eastern Ohio to canal routes. Such migrations might easily occur via fishes during the glochidial stage of these organisms. Stansberry (1961) has suggested that some of these anomalous geographic ranges can be better explained by alternate distributional histories. Clark and Wilson (1913) noted the abundance of naiades in the sections of canal joining the Wabash and Maumee rivers and suggested an interchange of the fauna of the watersheds. We have not attempted to evaluate distribution information on other aquatic animals, but it is possible that such an analysis would show similar results.

With little doubt, many different species of aquatic and wetland vascular plants, as well as terrestrial plants characteristic of disturbed habitats, were also transported in the canal system and became temporarily or permanently established in these newly created habitats. Evidence is available from historic records, early herbarium specimens, and current field work. Few records exist that mention plants seen along canal routes. John L. Riddell, Ohio medical botanist and author of the first comprehensive flora west of the Allegheny Mountains (Riddell 1834), traveled by canal and recorded many plants he observed. On a trip from Cincinnati to Lake Erie in the summer of 1835, Riddell journeyed up the Ohio River to Portsmouth and then via the Ohio and Erie Canal to Cleveland. Among the submersed plants that Riddell (1835) noted in his diary were *Nasturtium natans* DC. [=*Armoracia aquatica*] (Eat.) Wieg. (lake cress), *Myriophyllum heterophyllum* Michx., *M. verticillatum* L. (water milfoil), *Najas flexilis* (Willd.) Rostk. & Schmidt (slender naiad), *N. guadalupensis* (Spreng.) Magnus (Guadalupe naiad), *Potamogeton richardsonii* (A. Benn.) Rydb. (Richardson's pondweed), *P. compressus* L. [=*P. zosteriformis* Fernald] (flat-stemmed pondweed), *Ranunculus longirostris* Godr. (water crowfoot), and *Utricularia vulgaris* L. (bladderwort). Among emersed species were *Nelumbo lutea* (Willd.) Pers. (water lotus) and *Sagittaria rigida* Pursh (rigid arrowhead). Other pioneer botanists from Ohio who used canals for travel when botanizing were William S. Sullivant, Increase A. Lapham, Jonathan R. Paddock, Asa Horr, John M. Bigelow, John Locke, Milo G. Williams, Thomas G. Lea, and John S. Newberry. Their records are few and primarily restricted to an occasional herbarium specimen noted as originating from a canal.

In the twentieth century, the idea that the canals had a role in the migration of aquatic and wetland plants in Ohio was not totally ignored. In the introduction to his paper on "Rare Plants of Ohio" Jones (1943 p. 82) wrote: "Arthur Harper reports the presence of northern species in the abandoned canals of southern Ohio." This report is believed to be based on oral conversation, as no written account is known. Porter (1956) noted four species of submersed aquatic plants in the remnants of the Hocking Canal at Armitage. They were *Potamogeton pectinatus* L. (sago pondweed), *Potamogeton nodosus* Poiret (knotty pondweed), *Utricularia gibba* L. (humped bladderwort), and *Heteranthera dubia* (Jacq.) MacM. (water star-grass). Cusick and Silberhorn (1977) suggest that colonies of *Zizania aquatica* L. (wild rice) and *Iris shrevei* Small (southern blue flag) in an abandoned Tuscarawas County canal bed support the migration of plants through the canals. In a broader perspective, Svenson (1927) mentioned the Erie Canal as a possible migration route for the dispersal of plants across the state of New York. The Erie Canal has also facilitated the spread of the invasive *Lythrum salicaria* across New York State (Wilcox 1989). The spread of *Elodea canadensis* Michx. (waterweed) and of other foreign plants through the canals in Europe after their introduction has been widely discussed and documented (Sculthorpe 1967; references therein). The dispersal of sea-grasses into the eastern Mediterranean via the Suez Canal has also been documented (Sculthorpe 1967; Por 1971).

Materials and Methods

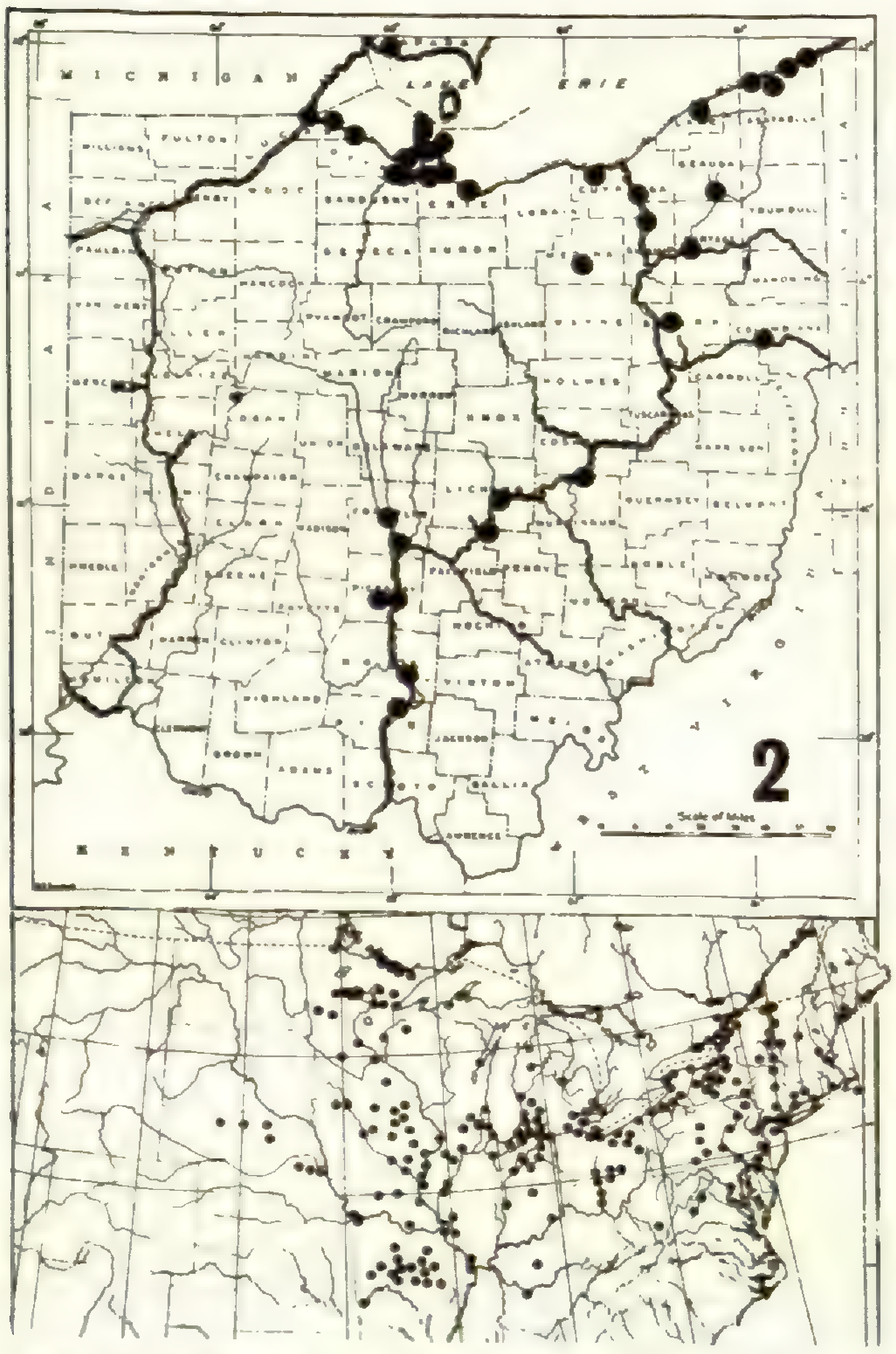
Distributional data of aquatic and wetland plants were assembled from literature sources, herbarium specimens, and field studies. Preliminary distribution maps of monocotyledonous plants were assembled from the card files of E. Lucy Braun at The Ohio State University Herbarium (OS). Additional specimens were examined at herbaria in Ohio at the University of Akron, Bowling Green State University (BGSU), The University of Cincinnati (CINC), The Cleveland Museum of Natural History (CLM), Kent State University (KE), Miami University (MU), elsewhere at the Academy of Natural Sciences of Philadelphia (PH), the Gray Herbarium of Harvard University (GH) the University of Illinois (ILL), Wiegand Herbarium of Cornell University (CU), the New York Botanical Garden (NY), and the New York State Public Museum at Albany (NYS). Additional records were obtained from unpublished sources such as letters, journals, and theses. Among the more noteworthy of these sources were the diaries and journals of John L. Riddell (Library, Tulane Univ.), letters of William S. Sullivant to Asa Gray (GH) and John Torrey (NY), and other records of early naturalists who traveled by canal.

The dot distribution maps of species in the United States have been compiled from dot maps in those state floras and state atlases where such maps have been compiled. Additional records have been obtained from specimens seen in herbaria: CU, IND, MICH, MO, NY, NYS, OKLA, OS, PENN, PH, US.

Difficulties in documentation arise from the use of older records and specimens with scanty locality and habitat data. Many of these ambiguous records were clarified by referring to supplemental information, including nineteenth century maps and county histories. Herbarium specimens documenting our own field studies of remnant canal sites in eastern, south-central, and northwestern counties are deposited in The Ohio State University Herbarium (OS).

RESULTS

NORTHERN SPECIES THAT HAVE MIGRATED SOUTHWARD IN OHIO CANALS. *Sagittaria rigida* Pursh (rigid arrowhead). An emersed plant of shallow water and mudflats in eastern and central United States, *S. rigida* was formerly common in the marshes of western Lake Erie (Moseley 1899; Pieters 1901), but is now rare (Lowden 1967; Moore 1973). A species of apparent southwestern or Ozarkian origin, it probably migrated northward and eastward into the Great Lakes region following retreat of the Wisconsinan Glacier. Alternatively, it may have survived in more extensive areas below the glacial border in eastern United States and moved northward and westward into the Great Lakes region following glaciation. In Ohio, the natural range of rigid arrowhead appears to be the marshes of western Lake Erie. Its distribution pattern southward in eastern and central Ohio correlates closely with the Ohio and Erie Canal (FIG. 2), suggesting that it migrated southward in the state via the canal. This migration evidently occurred soon after the canal was dug, as Riddell (1835 p. 64) noted *S. rigida* in the



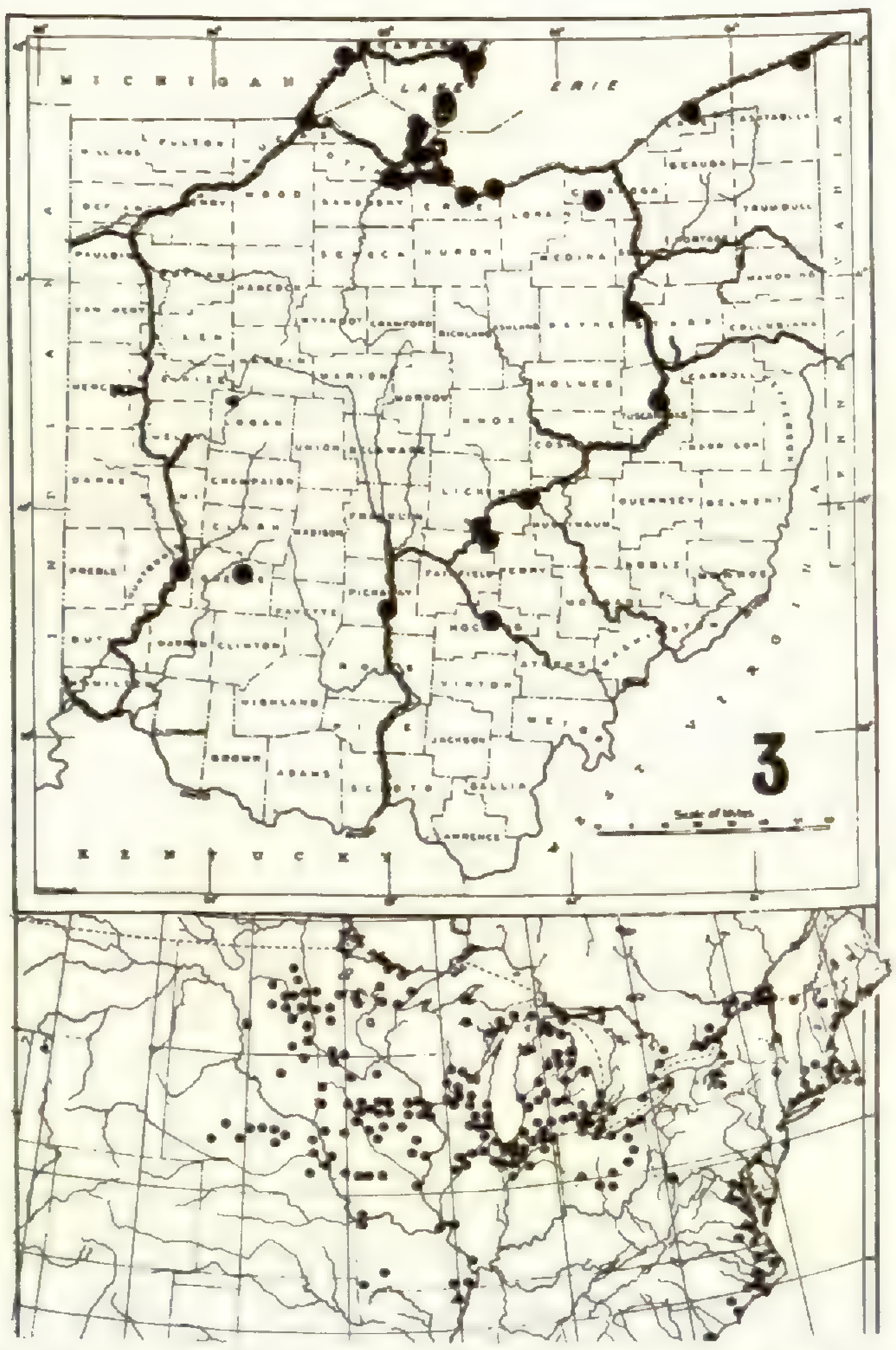


FIG. 2. Map of the distribution of *Sagittaria rigida* (rigid arrowhead) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower). FIG. 3. Map of the distribution of *Zizania aquatica* (wild rice) in relation to the canal system (above) and in the United States and Southeastern Canada (lower).

ponds about Newark and Paddock obtained a specimen from "Big Walnut, 5 mi s.e. of Columbus," 9 Aug 1840 (ILL). It persisted in the canal at Newark until at least 1891 (Jones 1892). At its southern-most location, Waverly, it was known as early as 1898 (*Clayton s.n.*, OS). Recent specimens from the Ohio and Erie Canal and its feeders are the shore of Guilford Lake at a picnic area in Columbiana County (12 Aug 1967, *Cusick s.n.*, KE); along Ohio Granger Hill Rd. at Valley View in Cuyahoga County (1979, *Andrus s.n.*, OS); southwest of Circleville in Pickaway County Ohio (26 Sep 1971, *Roberts 2207*, 25 Aug 1974 *Roberts 4469*, OS); and near where the canal enters Cuyahoga County in Summit County (1970, *Roberts 858*, OS).

Zizania aquatica L. (wild rice). An emersed species of lake shores and shallow flowing waters in eastern and central United States, *Z. aquatica* was once abundant in marshes along western Lake Erie as given in early accounts of travelers. Older herbarium specimens in the counties bordering Lake Erie come from Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, and Ottawa Counties. These localities probably represent the natural range of the species in Ohio, as *Z. aquatica* also is restricted to the lake region of Indiana (Deam 1940) and Pennsylvania (Wherry et al. 1979). Herbarium specimens and literature reports show that wild rice is closely associated with canal sites in Ohio (FIG. 3). Canals undoubtedly offered the appropriate slow currents and shallow soft substrates necessary for aeration of the submersed roots (Dore 1969) as well as for dispersal. Wild rice was obtained in the 1970s and 1980s in remnant canal sites in the Ohio and Erie Canal in Stark (*Roberts 5372*, OS), Tuscarawas (*Roberts 1999*, OS), Pickaway (*Roberts 2214*, OS), and Summit Counties (*Andreas 5489*, KE, OS). Wild rice has been known for many years at localities in Pickaway County (Shupe 1930), Stark County (10 Aug 1941, *Brown s.n.*, OS), and Tuscarawas County (10 Aug 1930, *Hicks s.n.*, OS). The small extant colonies of wild rice may be remnants of more extensive populations along the canals which now persist as seeds in the old canal beds and flourish at irregular intervals. Specimens are also known from Hocking, Licking, Montgomery, Perry, Stark, and Summit Counties which were all traversed by the canal system. The records from Hocking County ("old canal in a pond about a mile above Logan," Griggs 1914), Licking County ("Ohio Canal at Toboso," Jones 1892), and Perry County (Reservoir Park, 18 July 1895, *Kellerman s.n.*, OS), are all attributed to canal sites or canal system reservoirs. The record from Montgomery County is credited to Milo G. Williams (undated) of Dayton, Ohio, who noted it in his copy of Riddell's *Synopsis* under *Zizania aquatica:* "I first met with this in a mill race South of Dayton and sent a specimen to Dr. [John] Locke in 1833." Riddell (1834) credits this locality to Locke. The only other record of wild rice in southwestern Ohio is from Cedarville in Green County and did not come from a canal site. Perhaps the species was planted there.

Potamogeton richardsonii (A. Benn.) Rydb. (Richardson's pondweed). A submersed species of rivers and deep waters of lakes, *P. richardsonii* occurs in the northern Great Plains, the Great Lakes region, and northeastern United States southward into the Appalachian Mountains. In Ohio, it is most common in the island region of western Lake Erie, but it also occurs in the northeastern portion of the state where its distribution generally correlates with the Ohio and Erie Canal (FIG. 4). In his *Diary* (1835 p. 108) Riddell suggested that what is now called Richardson's pondweed was transported in the canal system. "In the canal [near Newport] I found *Potamogeton perfoliatum* [=*P. richardsonii*], . . . which plants had never occurred to me before in my botanical peregrinations." Later, Riddell (1836 p. 18) specifically recorded this pondweed from

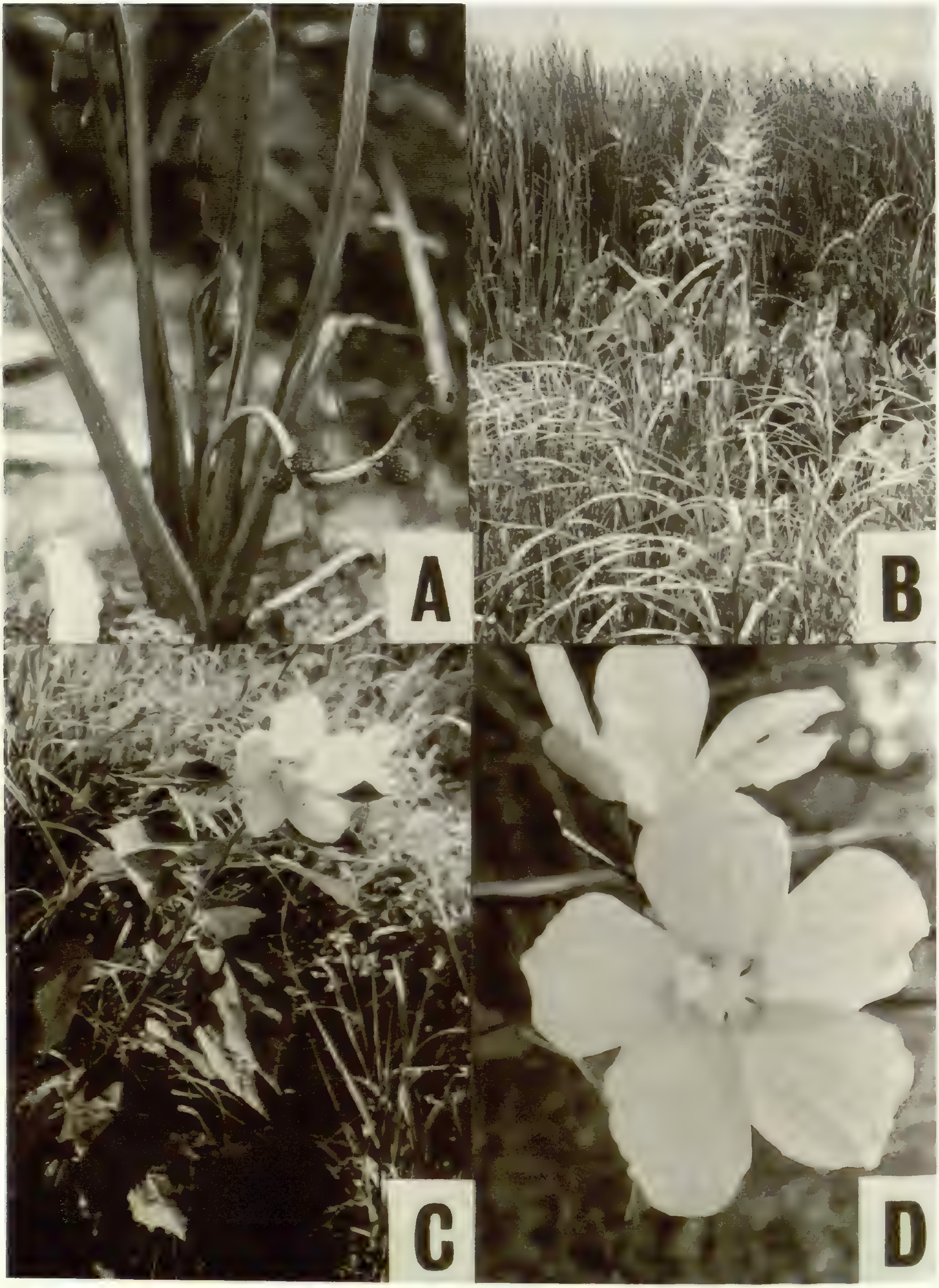
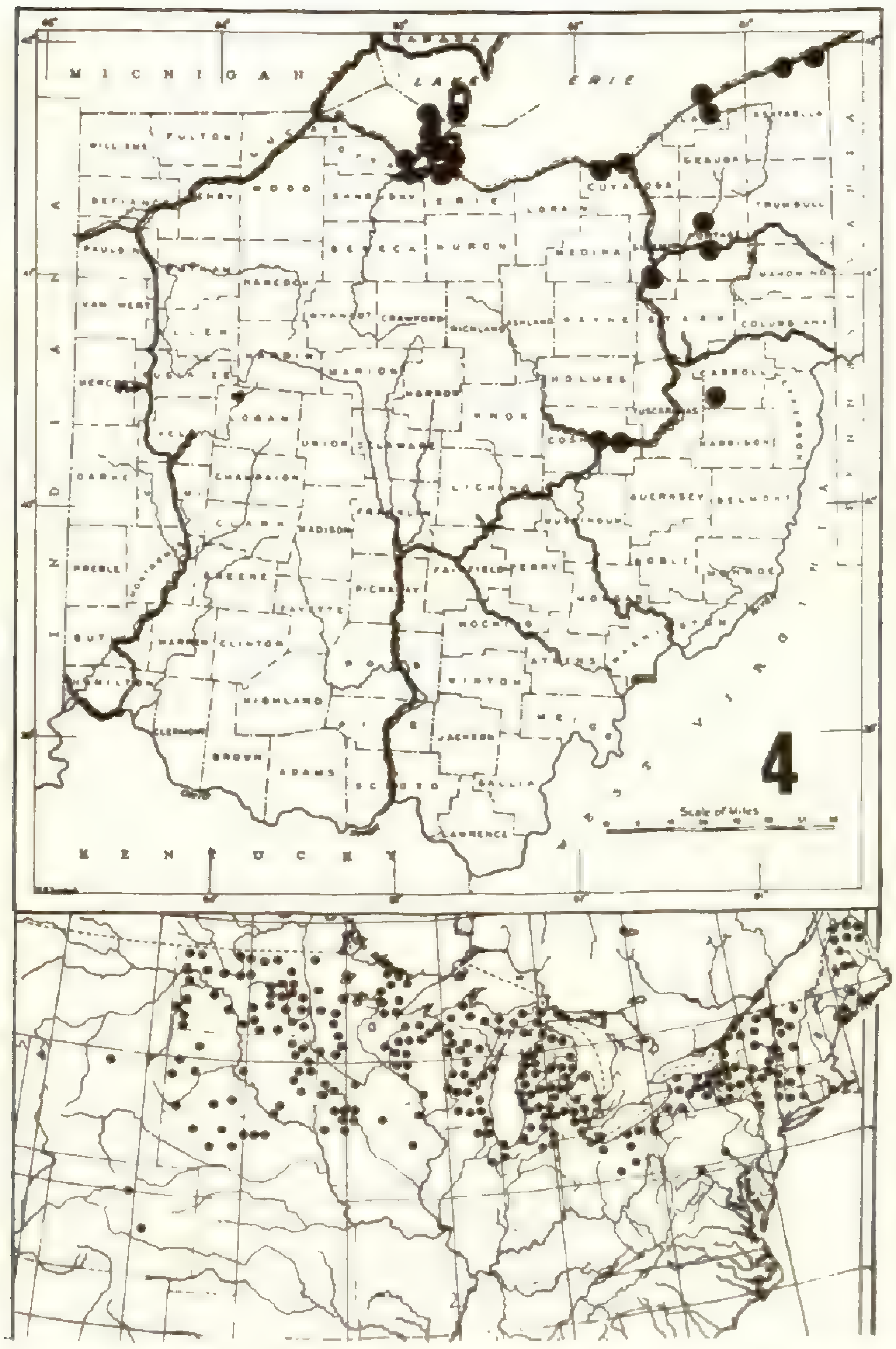


PLATE I. FIG. A. Photograph of *Sagittaria rigida* (rigid arrowhead); East Harbor State Park, September 1983, taken by Guy Denny. FIG. B. Photograph of *Zizania aquatica* (wild rice); East Harbor State Park, July 1968, taken by Ronald L. Stuckey. FIGS. C, D. Photographs of *Hibiscus palustris* (swamp rose mallow); pink corollas, Carp Pond, Kelleys Island, August 1978; C taken by Ronald L. Stuckey, D. taken by Mark Reinking.



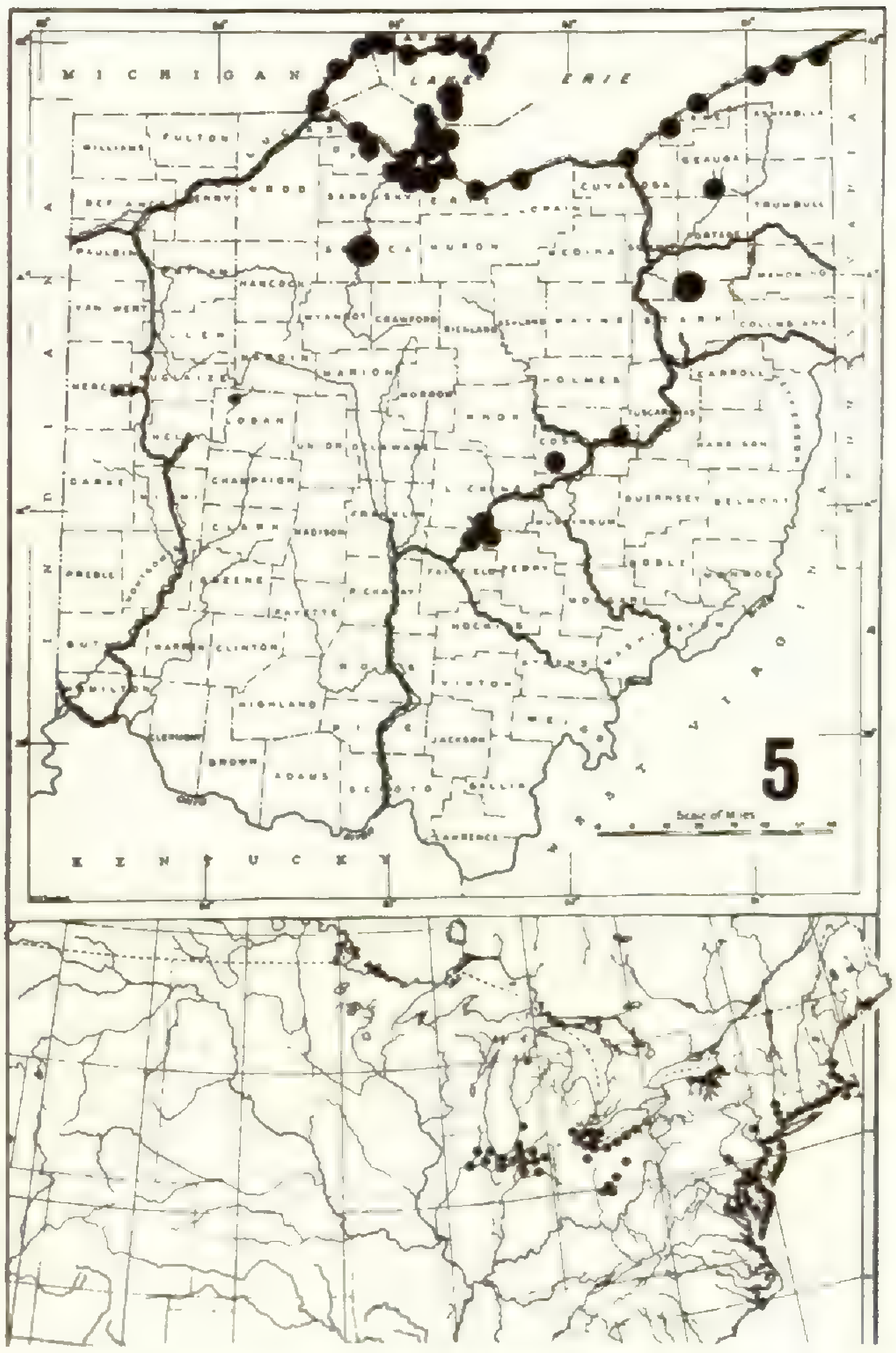


FIG. 4. Map of the distribution of *Potamogeton richardsonii* (Richardson's pondweed) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower). FIG. 5. Map of the distribution of *Hibiscus palustris* (swamp rose mallow) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower). Large dots on the Ohio map indicate populations probably escaped from cultivation.

the "Canal 5 miles north of Roscoe" (specimen at CINC). He also recorded the same species, under the name *P. lucens* L., "In the Summit Lake, and canal, near Akron" (specimen at CINC). Richardson's pondweed continued to persist for nearly 100 years near Roscoe, Coshocton County, based on the specimen of *Selby s.n.*, 1 Jul 1937 (OS). It was also collected from the canal-linked Brady Lake in Portage County (2 June 1913, *Hopkins 2159*, 1 Oct 1939, *Brown s.n.*, OS). An occurrence not associated with a canal is Leesville Lake in Carroll County (9 Aug 1961, *Cusick s.n.*, OS).

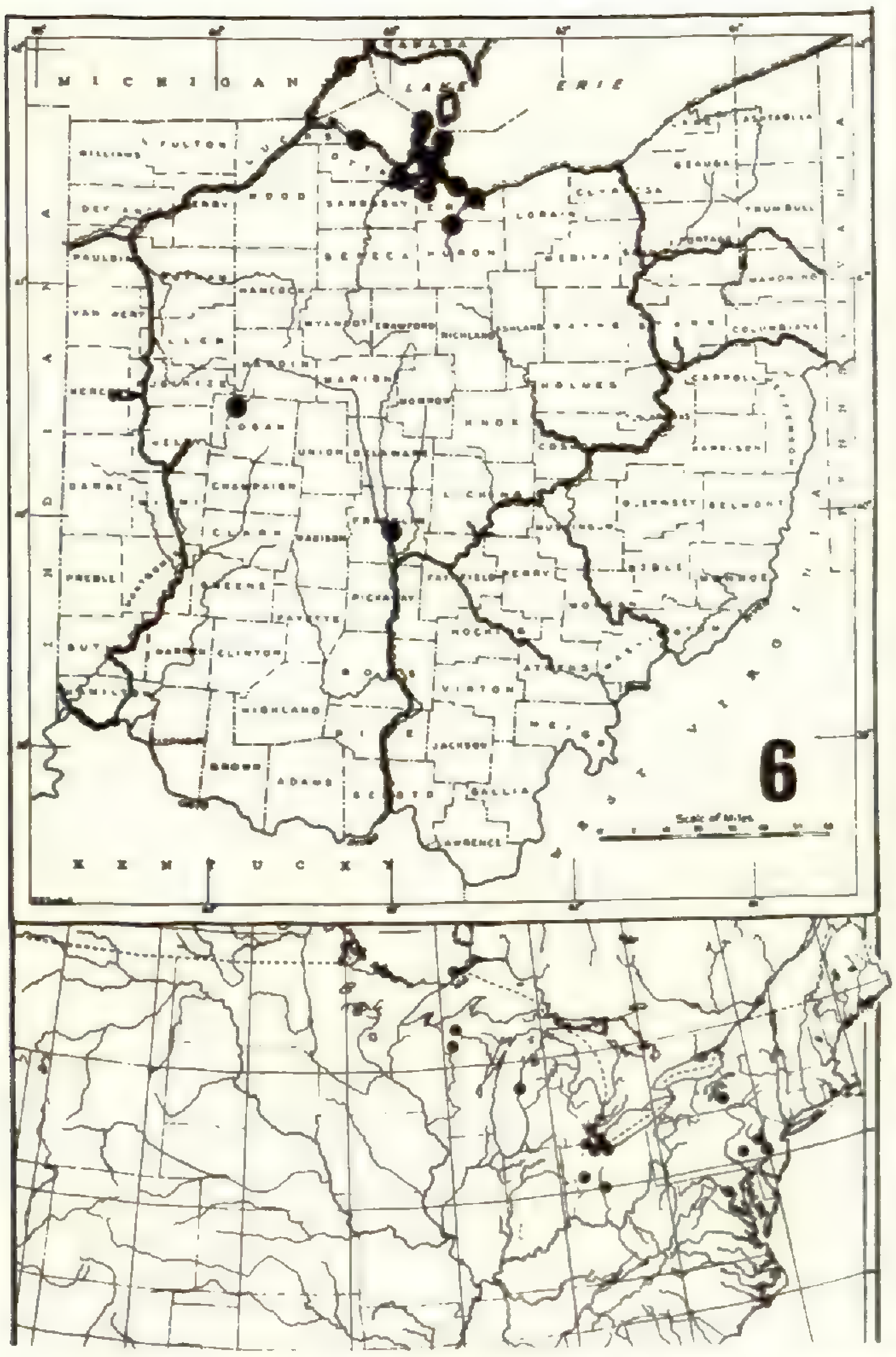
Hibiscus palustris L. [=*H. moscheutos* subsp. *palustris* (L.) Clausen, *H. moscheutos* L. of some authors] (swamp rose mallow). A tall shoreline, pink-flowered (occasionally white or red) species of rivers, lakes, and ponds, and an inhabitant of marshes, *H. palustris* occurs in the United States along the coast from Virginia to Massachusetts, and inland in marshes and on mudflats along the southern shores of Lakes Ontario, Erie, and Michigan (FIG. 5). In Ohio, swamp rose mallow is native and abundant in the marshes of western Lake Erie with records from every county along its south shore. Elsewhere in Ohio, the species is nearly confined to wetland remnants of the Ohio and Erie Canal through which its southward migration may have occurred in the state. Specimens (at OS) documenting these isolated canal remnants are from near Canal Lewisville in the North Appalachian Experimental Watershed in Coshocton County (2

Aug 1942, *Moldenke 13474*), 1 mile south of Millersport at the Deep Cut in Fairfield County (14 Jul 1972, *Roberts 2509*), Licking Reservoir [Buckeye Lake] in Licking County (31 Aug 1890, Jul 1893, *Wilcox s.n.*), Reservoir Park [at Buckeye Lake] in Perry County (Aug 1895, *Kellerman s.n.*), and at Zoar in Tuscarawas County (18 Aug 1973, *Roberts 4102*). At Buckeye Lake, the swamp rose mallow was reported as ''abundant in this one locality'' along its banks (Jones 1892), and also at Orchard Island, around the edge of Cranberry Bog, and ''common'' in the marshes (Detmers 1910, 1911, 1912). The plants have persisted along the shores of Buckeye Lake and Cranberry Island, and within the past 15 years have spread into the roadside ditches along Interstate Route 70, to about two miles west from Buckeye Lake. *H. palustris* is frequently planted as an ornamental in gardens and can escape from cultivation. Two colonies may represent such escapes: Wet depression in middle of Greenlawn Cemetery . . . at the edge of the city of Tiffin in Seneca County, 27 Aug 1974, *Stuckey 9539,* with petals pure white *9540* (OS); West end of Congress Lake, 1 mi north of Hartville in Stark County (8 Sep 1971, *Roberts 1963,* with deep red petals throughout *1964,* OS). As of 10 July 1985 the colony at Tiffin had been destroyed by filling the depression.

Bidens connata Muhl. var. *anomala* Farwell (beggars ticks). A widespread taxon of diverse wetland habitats occurring throughout northeastern North America west to the Great Plains, the var. *anomala* is more restricted and occurs along rivers and estuaries of the Atlantic Coastal Plain from Maryland to Quebec and inland into the Great Lakes region. These plants, which have the barbs on the awns of the achenes pointing antrorsely rather than the usual condition of pointing retrorsely as in var. *connata,* represent a variant that has been given formal taxonomic status. These phenotypes also occur inward along the sandy shorelines of Lakes Erie, Ontario, Huron, Michigan, and Superior. Antrorse individuals normally grow in mixed populations with retrorse individuals and cannot be readily distinguished by other characters. Although these entities are not considered worthy of taxonomic recognition (Roberts 1982), they do represent true-breeding polymorphisms with coherent geographic ranges. In the Great Lakes region the antrorse variant of the species is most frequent in sandy shoreline habitats, but has also been located in Ohio at two sites inland from Lake Erie (FIG. 6). These sites are near canals, and the earliest one was by A. D. Selby at an undetermined Franklin County locality, ''Lake Park,'' in 1899 and 1901 (OS, GH) and the second is based on specimens obtained in 1980 from Indian Lake (*Roberts 5506,* OS). The most plausible explanation for their occurrence at these two sites is dispersal and establishment along the canal system. The fruits of all varieties of *Bidens connata* are buoyant and resistant to waterlogging. However, the fruits of the antrorse phenotype do not adhere to other materials as readily as the widespread retrorse phenotype and are therefore less likely to be dispersed by animal vectors.

The only published account of the antrorse form of the introduced *B. connata* in Great Britain is from a canal, although the typical retrorse forms are more widely established in that country (Burton 1979). Antrorse plants have also been found ''along a canal'' at Leiden in the Netherlands (*van den Brink, Jr. 6573,* CU). Herbarium specimens also suggest the inland spread of the antrorse form in the canals of Maryland, New Jersey, New York, and Pennsylvania.

SOUTHERN SPECIES THAT HAVE MIGRATED NORTHWARD IN OHIO CANALS. *Hibiscus laevis* All. [=*H. militaris* Cav.] (halberd-leaved rose mallow, soldier rose mallow). A southern species of the Mississippi Embayment and southeastern United States (FIG. 7), *H. laevis* has spread northward in western Ohio. The plants grow on the lower banks



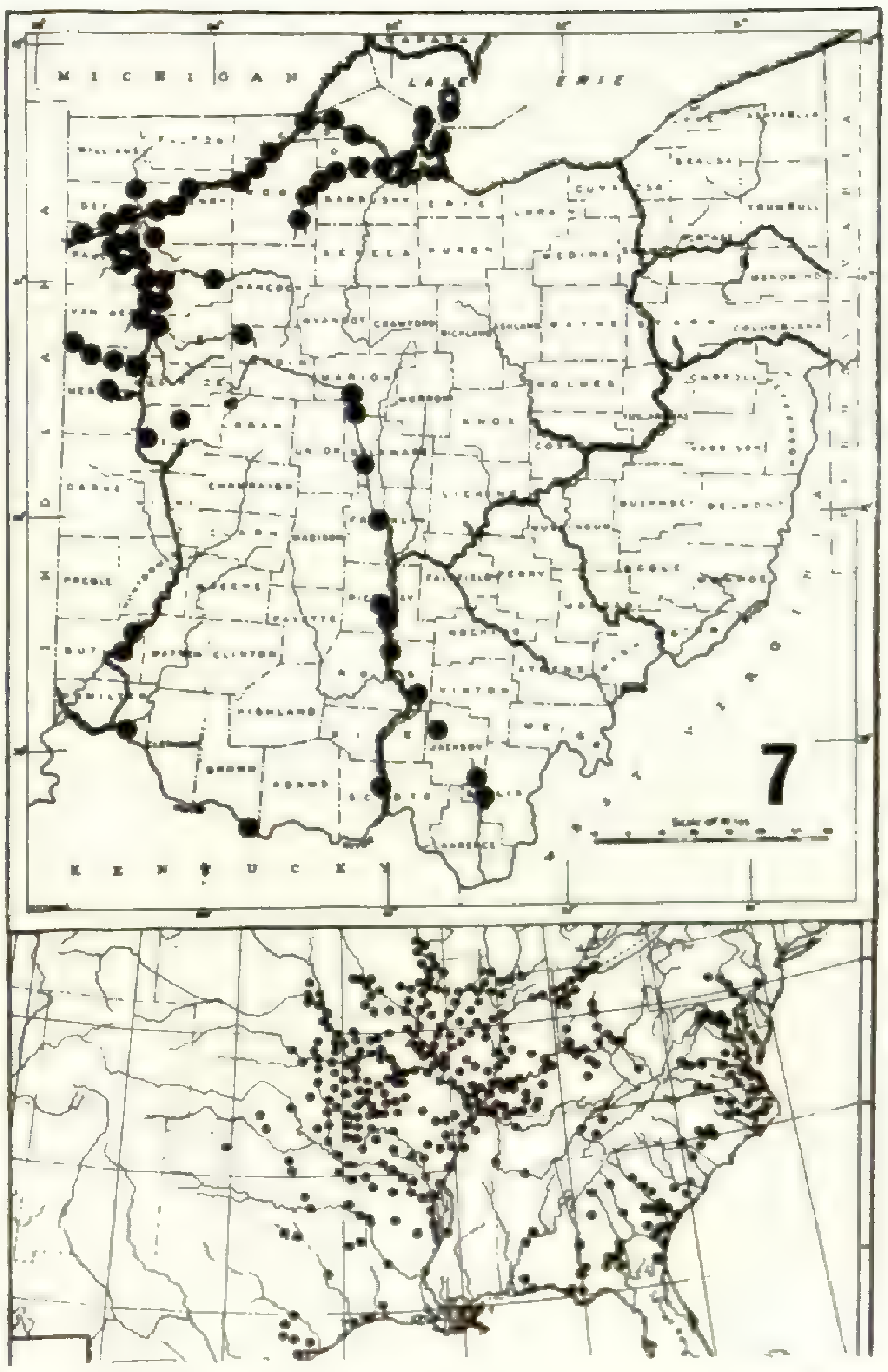


FIG. 6. Map of the distribution of *Bidens connata* var. *anomala* (beggars ticks) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower). FIG. 7. Map of the distribution of *Hibiscus laevis* [= *H. militaris*] (Halberd-leaved rose mallow) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower).

of streams and rivers adjacent to the water's edge, on sandy and muddy bars in watercourses, and on mudflats along the shores of canals and ponds. This rose mallow is common along the Maumee River and its southern tributaries, the Portage River, and the Scioto River, as well as along the Miami and Erie Canal and the southern portion of the Ohio and Erie Canal (FIG. 7). Its range in western Ohio was well established before 1900 as documented from early reports of the species from the vicinity of Columbus (Sullivant 1840) and Cincinnati (Lea 1849; Bodley 1865), and from herbarium specimens at key locations in Auglaize County at Grand Lake (27 Aug 1897, *Wetzstein s.n.*, MU), Butler County at Middletown ([1834,] *Riddell s.n.*, PH *n.d.*, *Williams s.n.*, Urbana College), along the Miami River near Trenton (*n.d.*, *Kreke s.n.*, CINC); Franklin County along the Scioto River, Columbus (1 Aug 1892, *Wilcox s.n.;* 17 Aug 1898, *Schaffner s.n.*, OS); Hamilton County in a pond near the mouth of the Little Miami River ([*n.d.*,] *Lea s.n.*, PH); and Lucas County at Toledo (Jul 1898, *Burglehaus s.n.*, OS). The 1897 specimen from Grand Lake suggests that the Miami and Erie Canal provided a vector for its dispersal into the Lake Erie watershed. Known to Moseley (1899 pp. 27, 113–114) only from near Toledo, and not in the area covered by his Sandusky Flora, *H. laevis* has spread and become established in that region since then. In the past 25 years, the species has appeared at several sites at the northeastern edge

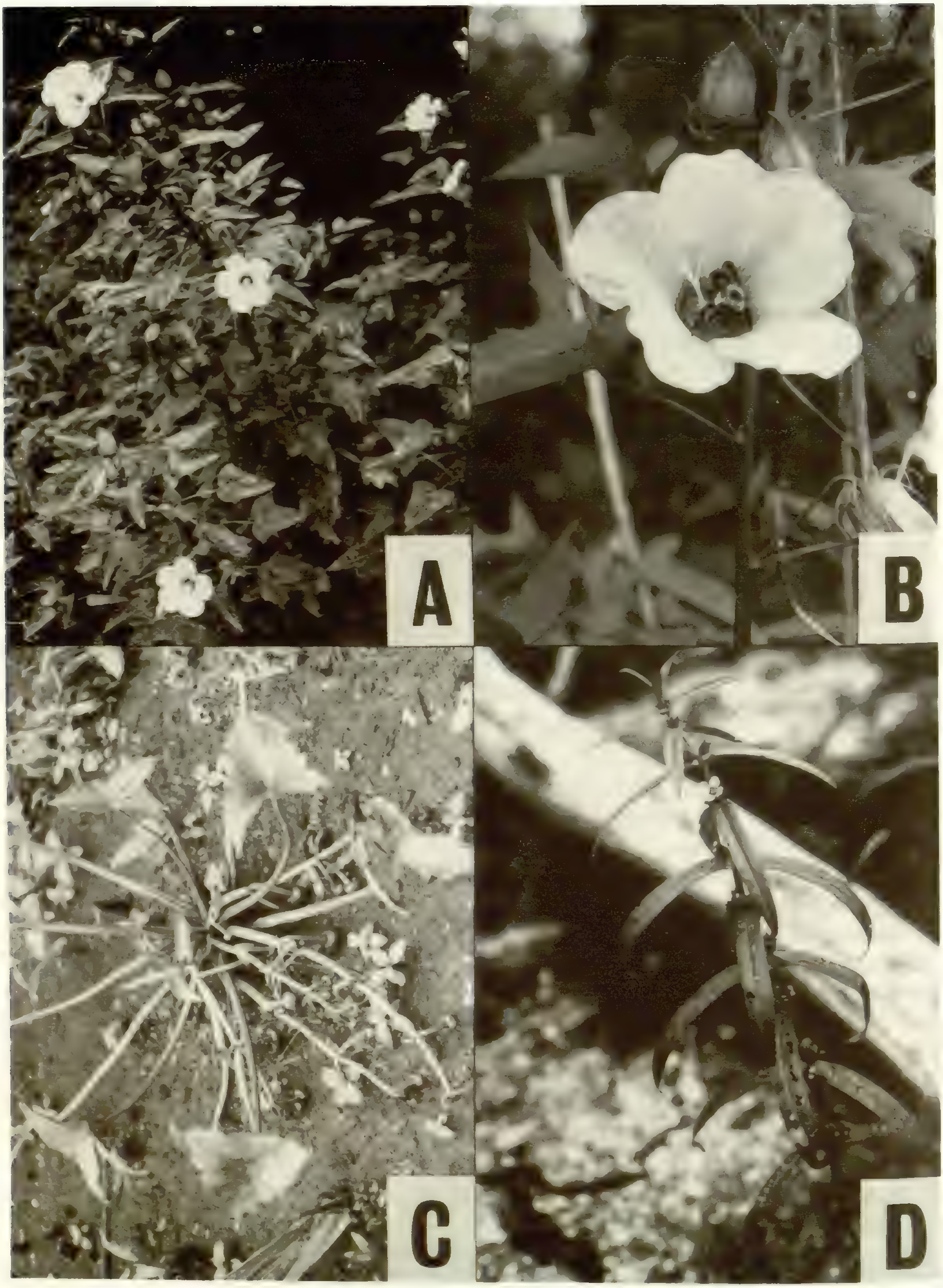
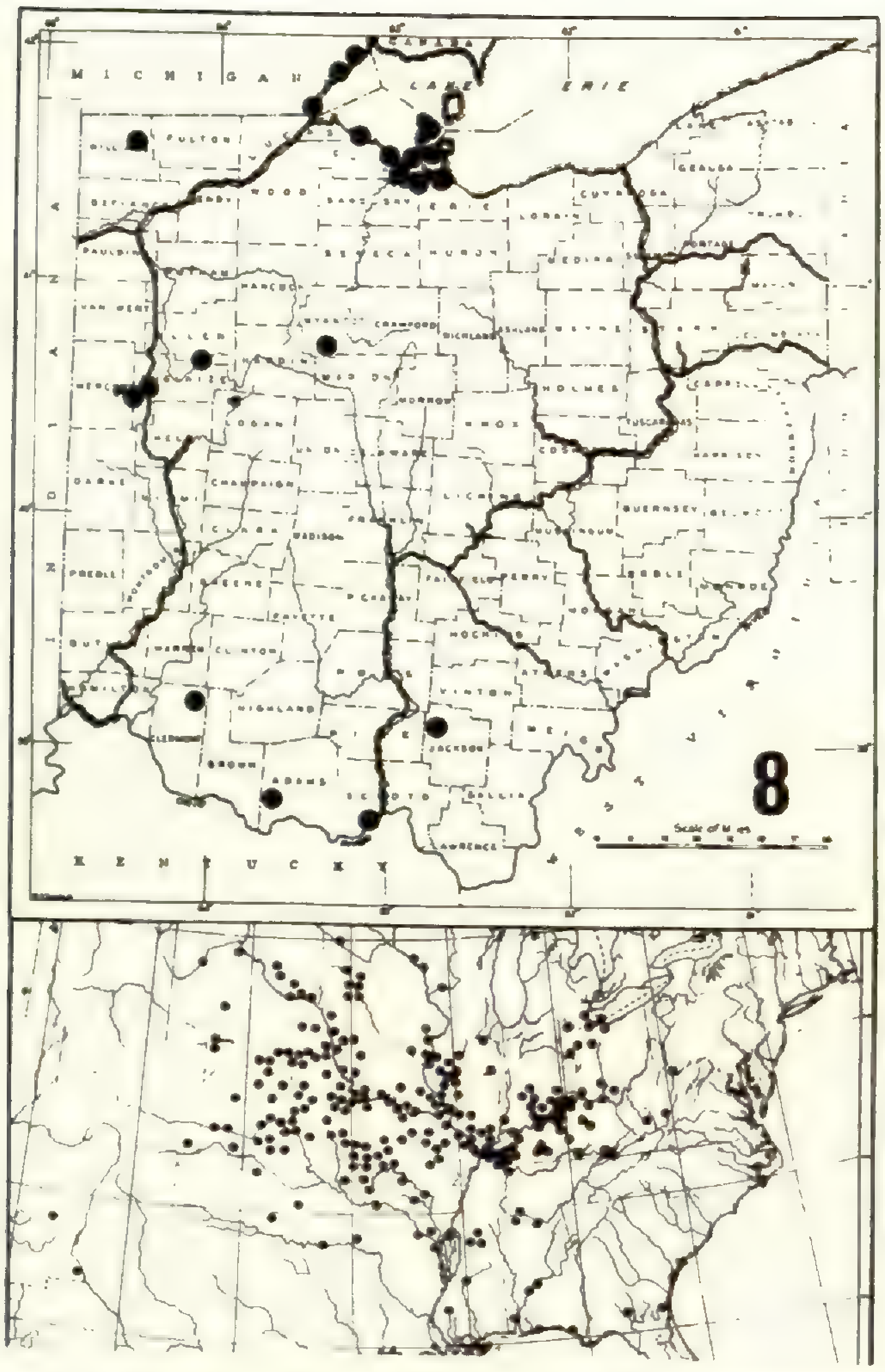


PLATE II. FIGS. A, B. Photographs of *Hibiscus laevis* (halberd-leaved rose mallow); A, Portage River northeast of Woodville, September 1967, taken by Ronald L. Stuckey; B, Carp Pond, Kelleys Island, August 1978, taken by Mark Reinking. FIG. C. Photograph of *Lophotocarpus calycinus* (lophotocarpus); Grand Lake St. Mary's near St. Mary's, September 1967, taken by Ronald L. Stuckey. FIG. D. Photograph of *Ammannia robusta* (ammannia); Winous Point, Sandusky County, October 1971, taken by Marvin L. Roberts.

of its range in western Lake Erie, among these being Magee Marsh in Lucas County, Lakeview Park in Port Clinton, East Harbor State Park and Fox's Marsh on North Bass Island in Ottawa County, and Carp Pond on Kelleys Island in Erie County (specimens at OS: Stuckey 1968).

Lophotocarpus calycinus (Engelm.) J. G. Sm. [=*Sagittaria calycina* Engelm.] (lophotocarpus, hooded arrowhead). A species of mudflats, *L. calycinus* is most common in the Mississippi Embayment but extends locally into the southeastern United States. Its extension northeastward in the Mississippi Valley across the Ohio-Erie divide into northwestern Ohio (FIG. 8) may represent a range extension that came about because of transport of propagules in canals. The earliest herbarium records known in the state are from along or near the Miami and Erie Canal at St. Mary's in Auglaize County (5 Jul 1898, *Wetzstein s.n.*, OS, MU; 5 Jul 1898, *Simkins s.n.*, OS), in western Lake Erie on Catawba Island in Ottawa County (4 Aug 1899, *Kellerman s.n.*, OS), and at Perkins in Erie County (1 Sep 1898, *Moseley, s.n.*, BGSU, OS). The species was evidently rare then in western Lake Erie as it was not reported by Pieters (1901) or Kellerman and Jennings (1904), and was mentioned from only one locality, "In a small pond bordering the southern boundary of Sandusky [Perkins Twp.]" by Moseley (1899). Lophotocarpus had not been reported for Ohio in earlier floras or state catalogs. The species has apparently spread locally onto the islands of western Lake Erie (13 Aug 1974, *Roberts 4433*, OS) in recent years. High water has created new mudflats on which lophotocarpus has become established. In Monroe County, Michigan, lophotocarpus has only been known since the late 1940s. All other isolated occurrences elsewhere in Ohio are from herbarium records at OS obtained since 1955, suggesting an additional recent expansion of its range in Ohio. The most recent specimen is from a roadside ditch in Williams County (3 Aug 1990, *Lammers 7375*, F, OS). Lophotocarpus is clearly a species of open sites characterized by natural or artificial disturbance and low levels of interspecific competition. The newly created canals and reservoirs would have provided habitats for its establishment in intermediate sites and a vector for its northward spread into suitable areas of northwestern Ohio.

Ammannia robusta Heer & Regel (ammannia). Recently recognized by Graham (1979) as a species distinct from the well-known *A.* × *coccinea* Rottb., *A. robusta* is a short plant of mudflats which is most common in the Upper Mississippi Embayment. Its extension northeastward in the Mississippi Valley across the Ohio-Erie divide into northwestern Ohio (FIG. 9) may represent a range extension that came about by the transport of propagules in canals. The earliest herbarium specimens known are from mudflats near old canal sites in northwestern Ohio and are documented by specimens (at OS) obtained during field work in September 1967 from Grand Lake St. Mary's in Auglaize County (*Stuckey 6218*), the Maumee River at Maumee in Lucas County (*Stuckey 5775*), the Auglaize River near Junction in Paulding County (*Stuckey 6188*), and the Maumee River at Waterville in Wood County (*Stuckey 5815*). However, the earliest known specimens from northwestern Ohio are Sandusky Bay at Presque Isle in Ottawa County (19 Aug 1895, *Moseley s.n.*, OS, US) and the town of Sandusky in Erie County (21 Aug 1909, *Detmers s.n.*). Moseley (1899) noted the ammannia as "local" for the Sandusky area, and suggested that its arrival and isolation at the northern edge of its range came about because the seeds may have stuck to the feet of birds that flew from southern riverbanks (Moseley 1897, 1899 p. 21). The recent distributional history of *A. robusta* in western Lake Erie parallels that of *Lophotocarpus calycinus* and the species now has been recorded from 16 known localities. Its expansion northward into



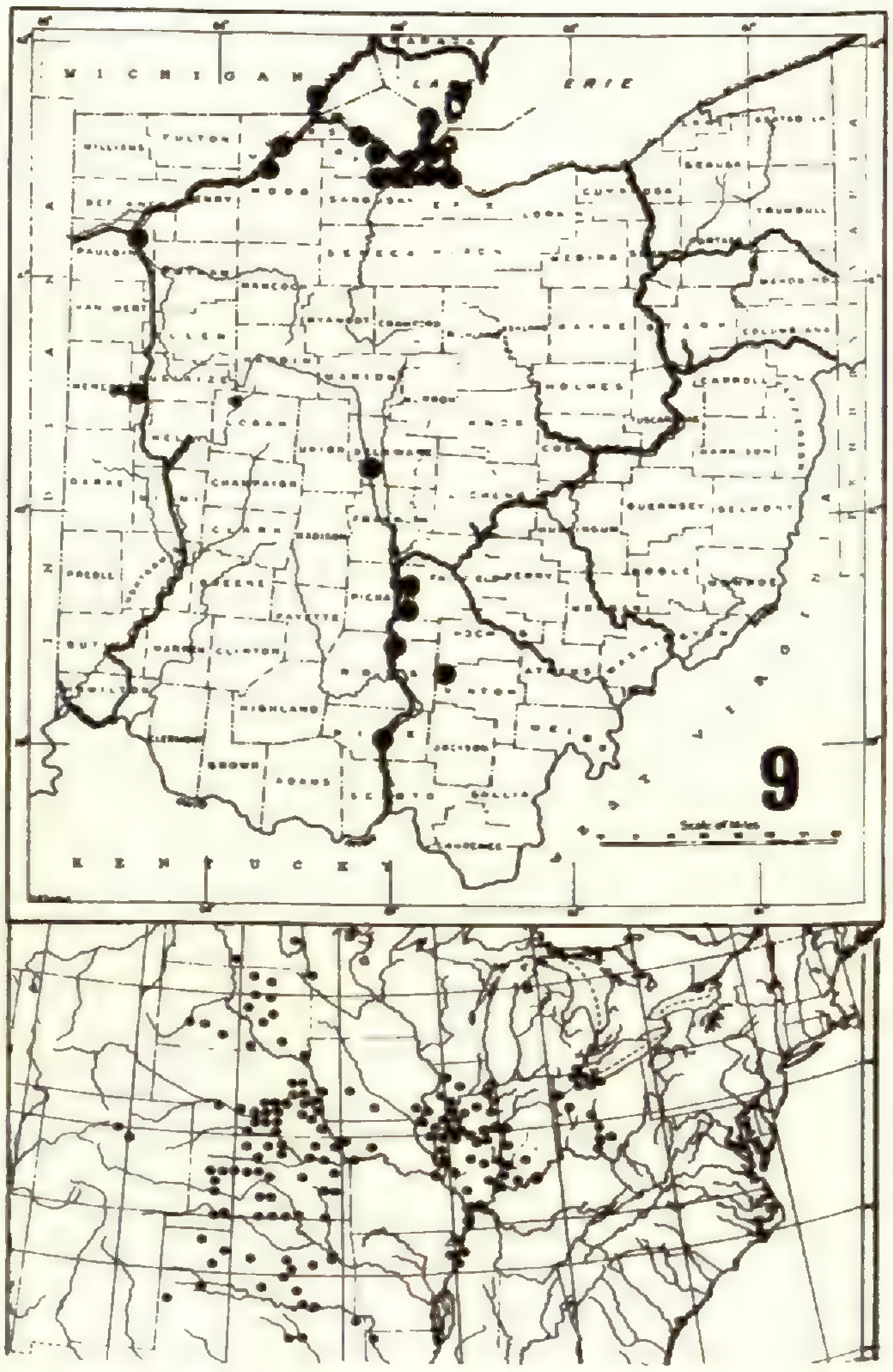


FIG. 8. Map of the distribution of *Lophotocarpus calycinus* [= *Sagittaria calycina*] (lophotocarpus, hooded arrowhead) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower). FIG. 9. Map of the distribution of *Ammannia robusta* (ammannia) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower).

Monroe County, Michigan, and onto the islands in western Lake Erie and the south shore of mainland Canada has been particularly evident in the 1970s during the high water-levels of Lake Erie (specimens at MICH and OS, Stuckey 1968, Campbell and Reznicek 1977). The occurrence of *A. robusta* in the Scioto Valley dates only from the 1930s (specimens at OS) and suggests that canals were probably not a factor in this later spread.

Azolla caroliniana Willd. (mosquito fern). A floating fern of quiet water usually in duckweed communities, *A. caroliniana* reaches the northern limits of its range in the southern Great Lakes region. It was discovered as early as 1813 by Pursh in marshes along Lake Ontario in New York (Pursh 1814). Its natural distribution extends along the Atlantic Coastal Plain and northward in the Mississippi Embayment to southern Minnesota. It is uncommon or absent from much of the Allegheny Plateau region. Mosquito fern is common and probably native in protected shoreline marshes and ponds in western Lake Erie. Elsewhere in Ohio its distribution is almost entirely restricted to sites associated with the canal system (FIG. 10). The earliest record of *A. caroliniana* is a specimen cited by Svenson (1944 p. 82, as *A. mexicana* Presl.) without mention of state or collector, "2 miles south of Columbus, overflow of Canal by Morrells, Sep. 18, 1841" (specimen at GH). This locality is unquestionably in southern Franklin County.

At that time a farmer named Moses Merrill lived along the Columbus Feeder Canal (Martin 1858). Additional specimens of *A. caroliniana* not cited by Svenson include one labeled "Columbus, Ohio, 1846" by W. S. Sullivant (NY) and another collected by Sullivant and labeled "banks" (PH). It is probable that the 1841 specimen cited by Svenson is also a collection of Sullivant. A number of Sullivant specimens variously labeled are at GH. Clark and Wilson (1913) reported that *Azolla caroliniana* was abundant in stretches of the Miami and Erie Canal in Henry County in 1908. It was also obtained from remnants of the canal near Toledo (19 Oct 1901, *Burglehaus s.n.*, OS). An older specimen from Hamilton County (ca. 1900, *Dyer s.n.*, OS) may also be from a canal site. In the Ohio and Erie Canal system, mosquito fern has been located in the Portage Lakes (Oct 1929, *Blaydes s.n.*, OS), and in remnants of the Ohio and Erie Canal itself in Ross, Stark, and Tuscarawas Counties in the 1970s (*Roberts 2215, 4086, 4118*, respectively, OS).

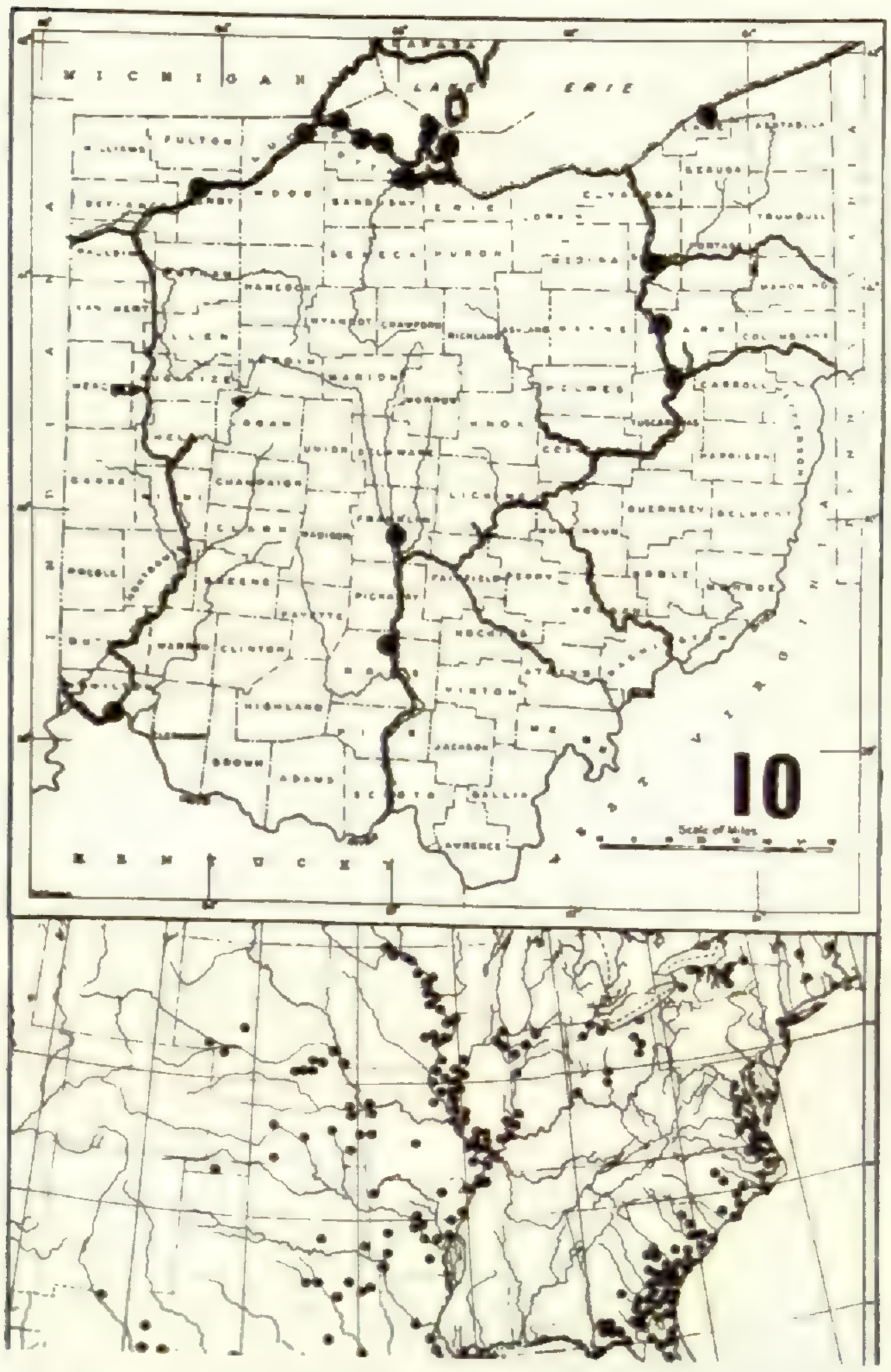
The inland Ohio localities may have resulted from the transport of this species southward through the canals from populations in Lake Erie, and may have been supplemented by intentional introductions into the canals for mosquito control. Elsewhere, *Azolla caroliniana* was first discovered in New Jersey in the Delaware and Essex Canal (Benedict 1923) and later in the Morris Canal (Cohn and Renlund 1953). The inland distribution of mosquito fern in central New York also appears to be correlated with the Erie Canal system.

Nelumbo lutea (Willd.) Pers. (American water lotus, water chinquapin). A rooted aquatic plant of shallow lakes or protected bays of deeper lakes, *N. lutea* was once considered abundant only in the shallow bays of western Lake Erie where extensive populations were frequently noted by early travelers (Kirtland 1858, Hildreth 1837) and botanists (Moseley 1899, Claassen 1892, Pieters 1901). The American water lotus is a southern species of the Atlantic Coastal Plain and inland in the Mississippi Embayment where it approaches the northern limits of its distribution in the Ohio waters of Lake Erie (FIG. 11). Moseley (1931) attributed the presence of the water lotus in northwestern Ohio to transport of seeds by Indians. This hypothesis was made more credible by the subsequent discovery of seeds in prehistoric archaeological sites as far north as Isle Royale, Michigan (Yarnell 1964). Early settlers commonly thought the water lotus possessed various mystical properties and therefore noted its presence and attempted to propagate the plant from natural populations (Kirtland 1859). The natural distribution of the water lotus in Ohio may have therefore been complicated by these two factors before canal construction was initiated.

Caleb Atwater wrote in an undated letter to Prof. Parker Cleaveland (in the Cincinnati Historical Society Library) that he had found the plant "in our wet prairies." Water lotus was mentioned in correspondence of Chillicothe and Zanesville resident Daniel Steinhauer to Schweinitz in approximately 1820 from "swamps of this country" while he was a resident of Chillicothe (Stuckey 1967). A Geauga County population from "Munson Pond" (probably the present day Bass Lake) noted by Kirtland (1859) and a specimen from a pond at Columbia, Hamilton County ([*n.d.*, 1834–1844 fide Braun 1934,] *T. G. Lea s.n.*, PH) document other inland occurrences. *Nelumbo lutea* therefore occurred sporadically in localities inland from Lake Erie and the Ohio River before canal construction. The creation of the reservoirs associated with the canal apparently provided additional appropriate habitats which were rapidly colonized. Hildreth (1837) observed the plant in the Portage Lake region while traveling by canal. By the 1890s American water lotus had been collected in the Licking Reservoir (Aug

1891, *W. C. Werner s.n.*, OS, CLEVE), Grand Lake St. Mary's (St. Mary's, Miller's Pond, 6 Aug 1894, *J. D. Simkins s.n.*), and Congress Lake (Aug 187 [sic], [*Claypole s.n.*,] Akron Univ. Herb.; 6 Aug 1936, *Brown s.n.*, OS). It was later found in Loramie Reservoir (2 Jul 1934, *Schaffner s.n.*, OS). The above localities include all of the major canal storage lakes other than Lewiston Reservoir (Indian Lake). It was also collected from "Odell's Lake" in Holmes County (Aug 1898, *Stair s.n.*, CLM) and a pond near the Ohio State University campus in Franklin County (Aug 1890, *Wilcox s.n.*, OS). American water lotus was subsequently collected in the Scioto River drainage in Pickaway (Nov 1935, *Bartley and Pontius, s.n.*, OS), Ross (23 Jul 1936, *Bartley and Pontius, s.n.*, OS), and Scioto Counties (20 Jul 1981, *Spooner and Anderson 807*, OS). Recently it has invaded or been introduced into newer artificial reservoirs such as Cowan Creek Reservoir (28 Aug 1953, *Terrell 2793*, OS; *Roberts 1821*, OS), Grant Lake (4 Aug 1971, *Roberts 1791*, OS) and Senecaville Lake (26 Aug 1970, *Cusick s.n.*, KE). It is perhaps questionable whether the actual spread of the plant was by canal or whether the canals and associated improvements simply provided suitable habitats in areas of Ohio where the species had previously not existed.

Hisbiscus mosheutos L. [including *H. palustris* L. of some authors] (swamp rose mallow). A tall shoreline, white-flowered with a dark pink center, species of rivers,



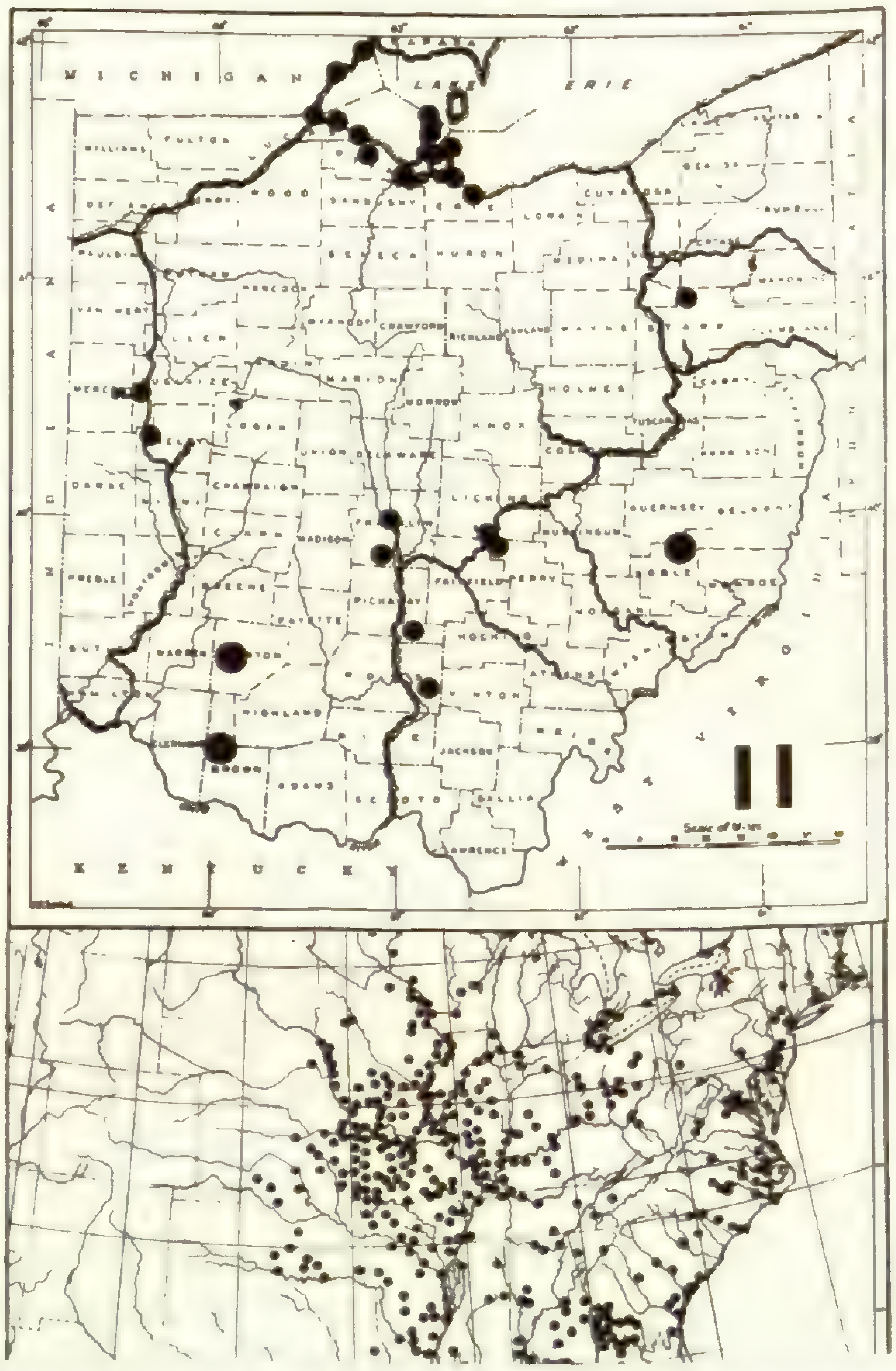


FIG. 10. Map of the distribution of *Azolla caroliniana* [including *A. mexicana*] (mosquito fern) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower). FIG. 11. Map of the distribution of *Nelumbo lutea* (American water lotus, water chinquapin) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower). Large dots on the Ohio map indicate recent populations established at artificial lakes and reservoirs.

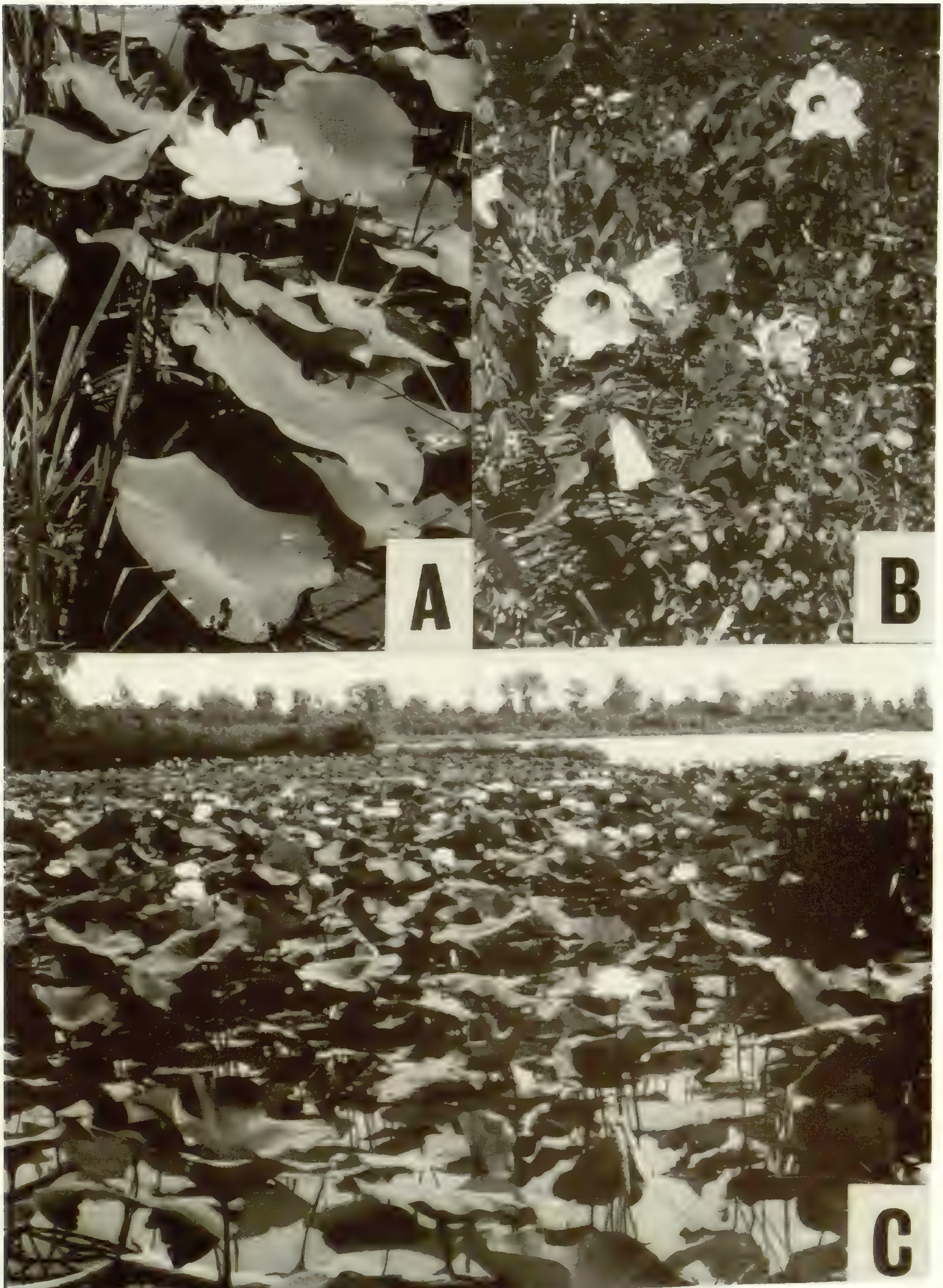
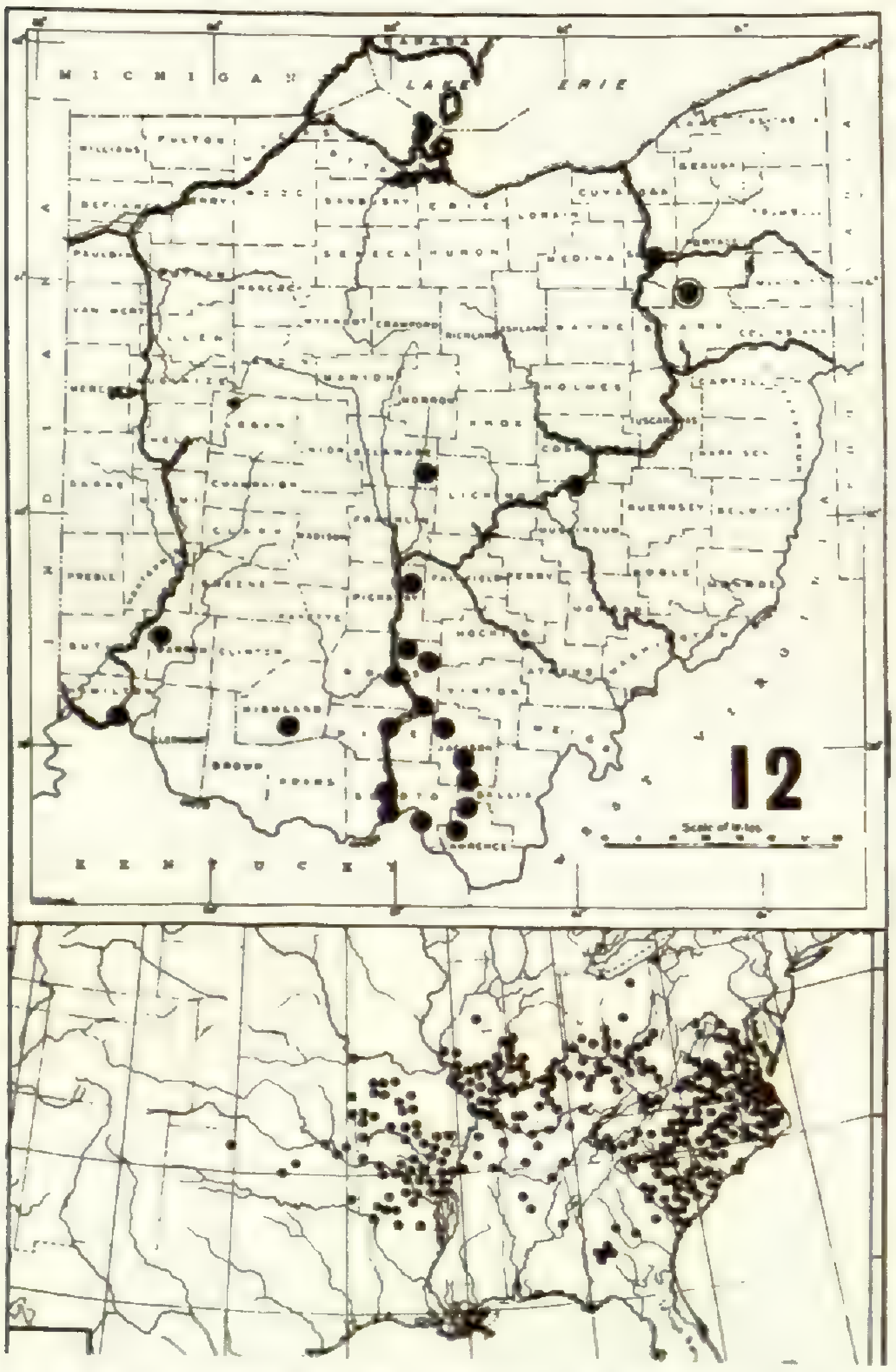


Plate III. Figs. A, C. Photographs of *Nelumbo lutea* (American water lotus, water chinquapin); East Harbor State Park, August 1979, taken by Ronald L. Stuckey. Fig. B. Photograph of *Hibiscus moscheutos* (swamp rose mallow); white corollas with dark-red centers, Ohio & Erie Canal north of Portsmouth, September 1973, taken by Marvin L. Roberts.

lakes, and ponds, *H. moscheutos* occurs throughout the southeastern United States and the Mississippi Embayment (FIG. 12). In Ohio, this rose mallow is known from several southern Ohio counties, but has evidently migrated northward where it persists in remnants of the Ohio and Erie Canal (FIG. 12). Specimens (at OS) have been obtained from canal remnants at Lake White in Pike County (2 Sep 1971, *Roberts 1683,* OS), in a pond at the west edge of Chillicothe in Ross County (Stuckey, site observation), and north of West Portsmouth in Scioto County (3 Sep 1981, *Stuckey 10362;* 1 Sep 1973, *Roberts 4209*). The species may have migrated northward along the Ohio and Erie Canal as documented from specimens (at OS) from Adams Mills in Muskingum County (8 Apr 1942, *Moldenke 12204*), about 3 miles west of Cuyahoga Falls in Summit County (29 Aug 1955, *Herrick s.n.*). The most recent northern extension of its range is a specimen obtained from the northwest shore of Hoover Reservoir, Delaware County (26 Oct 1990, *Stuckey s.n.,* OS). Populations from Lakeville in Holmes County (6 Jul 1899, *Selby and Duvel 791*), Congress Lake in Stark County (8 Sep 1971, *Roberts 1961,* [perhaps escaped from cultivation]), and Mosquito Creek Reservoir at Mecca in Trumbull County (21 Aug 1971, *Wentz 557*) are not closely associated with canal improvements. The specimen (at CINC) obtained from the Vine Street Cemetery in the Cincinnati suburb of Cliffton in Hamilton County may have been planted.



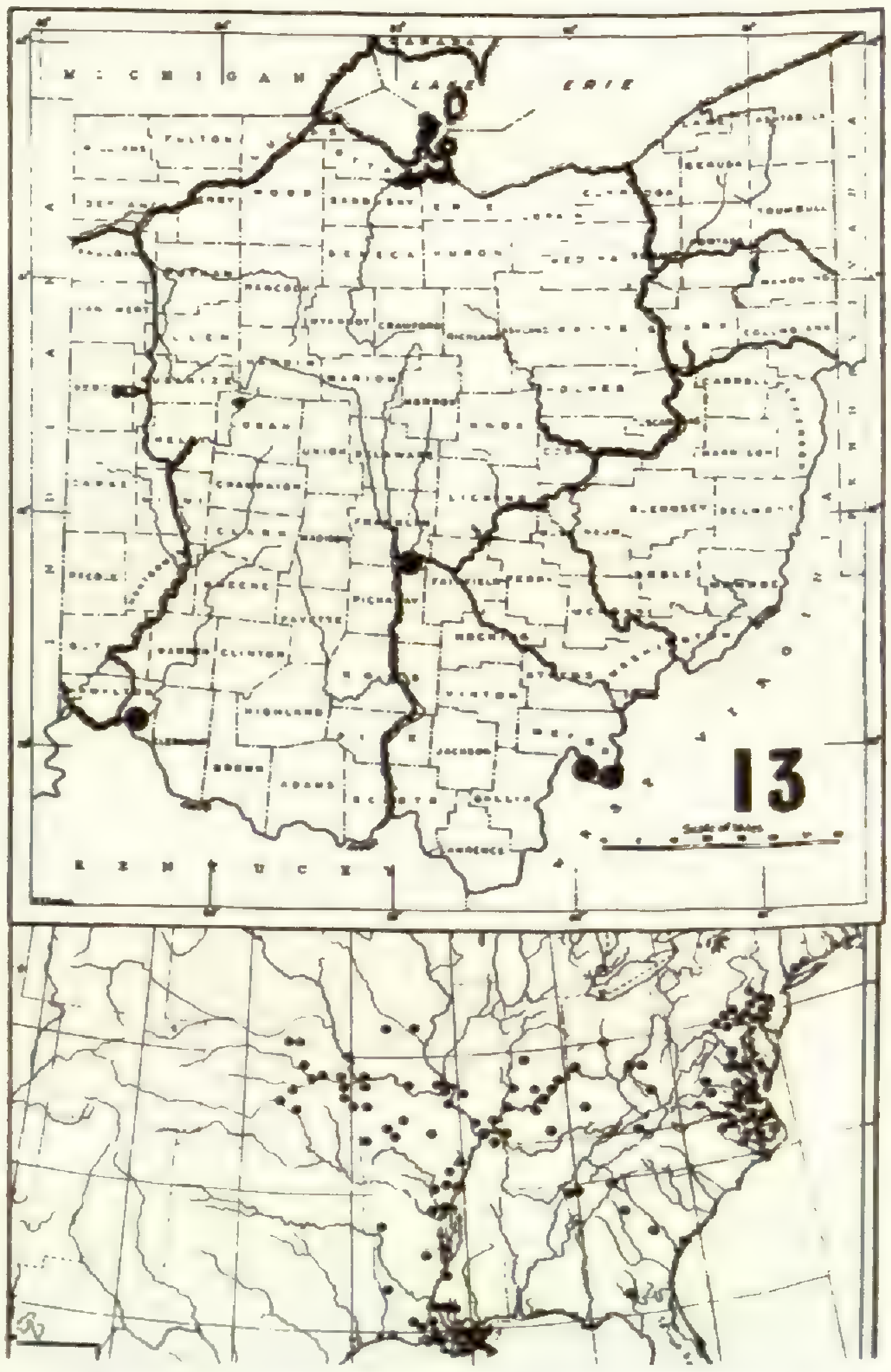


FIG. 12. Map of the distribution of *Hibiscus moscheutos* (swamp rose mallow) in Ohio in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower). The large dot in Northern Ohio may represent a population escaped from cultivation. FIG. 13. Map of the distribution of *Heteranthera dubia* (mud-plantain) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower).

Heteranthera reniformis R. & P. (mud-plantain). A species of mudflats and shallow water in the southern United States, its northward spread into Ohio apparently came about by the canals at an early date (FIG. 13). Riddell (1834 p. 90) reported *H. reniformis* from "Lockborne, O[hio]" where the plant apparently was noticed on the mudflats near the canal south of Columbus where he traveled and often botanized. In Hamilton County, this species came from a "Muddy shore of pond near Little Miami, 1837" from a collection made by T. G. Lea (PH) and reported by Braun (1934 p. 25). The 1849 record from Montgomery County cannot be confirmed (Stuckey and Roberts 1977). The species has recently been relocated on mudflats along the Ohio River in Meigs County (27 Oct 1986, *Ortt and Cusick 26170,* OS) and adjacent areas of West Virginia (Cusick 1988). Mud-plantain is common along the Mississippi River and the minute seeds may have been carried in mud associated with cargo brought up the Ohio River and then inland by canal.

Najas guadalupensis (Spreng.) Magnus (Guadalupe naiad, southern naiad). A delicate, rooted submersed aquatic plant occurring throughout the United States, *N. guadalupensis* was sporadic in distribution in the northern portion of its range before 1900. Since then it has spread into man-made lakes, ponds, and reservoirs where it is becoming a common and sometimes nuisance species. The northward spread of *N. guadalupensis* into Ohio may have come about by plants having been carried in the canals. Two specimens from the central part of the state were obtained before 1850 from the canal at Roscoe in Coshocton County ([Jul 1835,] *Riddell s.n.,* CINC) and from "Columbus, canals" in Franklin County ([*n.d.,*] *L. Lesquereux s.n.,* K). In Hamilton County specimens were taken from "Longworth's pond & ditch, Columbia" (1 Sep 1837, *Lea s.n.,* PH). Specimens obtained in the 1890s in Ohio all come from waterways associated with canals (Auglaize Co.: Reservoir [Grand Lake St Mary's,] 13 Aug 1899, *Duvel s.n.,* OS; St. Mary's, 3 Sep 1900, *Wetzstein s.n.,* OS: Erie Co.: Sandusky Bay, 24 Sep 1896, *Moseley s.n.,* F, GH; Ottawa Co.: Put-in-Bay, 27 Jul 1898 US, 29 Jul 1898 MICH, Aug 1898 US, *Pieters s.n.*).

Since 1900 *N. guadalupensis* has spread away from the canals into newly created man-made lakes, ponds, and reservoirs (Wentz and Stuckey 1971). These locations are shown on the map (FIG. 14) and are documented with specimens (at OS). Clausen (1936) mentioned that large quantities of the species occurred in the canal at Keuka Lake, New York. Similar proliferation of the species and expansion of its range is particularly evident in Illinois, Kansas, Oklahoma, and southern Minnesota, a phenomenon which evidently has become manifest in the past 40 years. Plants have been obtained from canals in Delaware, Florida, Iowa, Louisiana, Maryland, and Texas (data from specimens supplied by R. R. Haynes).

DISCUSSION

Present distributions of selected submersed and emersed vascular plants illustrate that certain northern species survive in abandoned canals southward in Ohio. At the same time southern species extend northward in sites associated with canals. At least two patterns are recognizable: (1) Species originally present in western Lake Erie and the Lake Erie watershed which migrated southward into the new canals are *Sagitarria rigida, Zizania aquatica, Potamogeton richardsonii, Hibiscus palustris,* and *Bidens connata* var. *anomala;* (2) Mississippi Embayment and Southeastern species with northward extensions into the Miami and Erie Canal and the Ohio and Erie Canal are *Hibiscus laevis, Lophotocarpus calycinus, Ammannia robusta, Azolla caroliniana, Hi-*

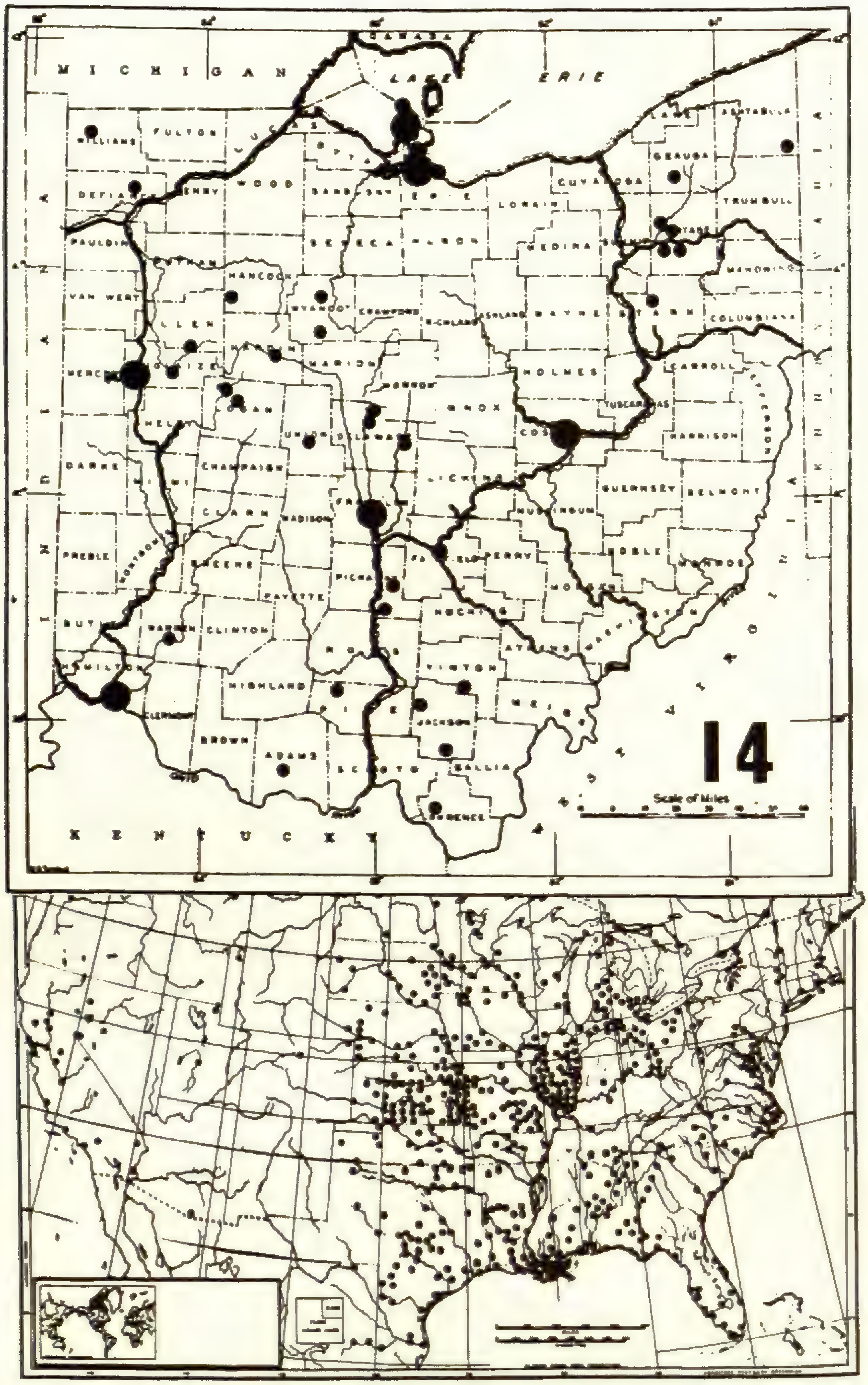

CANADA
MICHIGAN
LAKE ERIE
WILLIAMS
FULTON
LUCAS
OTTAWA
DEFIANCE
HENRY
WOOD
SANDUSKY
ERIE
LORAIN
CUYAHOGA
LAKE
ASHTABULA
GEAUGA
TRUMBULL
PAULDING
PUTNAM
HANCOCK
SENECA
HURON
MEDINA
SUMMIT
PORTAGE
MAHONING
VAN WERT
ALLEN
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
WAYNE
STARK
COLUMBIANA
MERCER
AUGLAIZE
HARDIN
MARION
MORROW
HOLMES
CARROLL
JEFFERSON
KNOX
TUSCARAWAS
LOGAN
UNION
DELAWARE
COSHOCTON
HARRISON
DARKE
MIAMI
CHAMPAIGN
LICKING
GUERNSEY
BELMONT
CLARK
MADISON
FRANKLIN
MUSKINGUM
PREBLE
MONTGOMERY
GREENE
FAIRFIELD
PERRY
NOBLE
MONROE
PICKAWAY
FAYETTE
MORGAN
WASHINGTON
BUTLER
WARREN
CLINTON
HOCKING
ATHENS
HAMILTON
CLERMONT
HIGHLAND
ROSS
VINTON
MEIGS
PIKE
JACKSON
BROWN
ADAMS
SCIOTO
GALLIA
LAWRENCE
OHIO
KENTUCKY
INDIANA
PENNSYLVANIA
WEST VIRGINIA
14
Scale of Miles

FIG. 14. Map of the distribution of *Najas guadalupensis* (Guadalupe naiad, southern naiad) in relation to the canal system in Ohio (above) and in the United States and Southeastern Canada (lower). On the Ohio map large dots represent locations where plants were obtained before 1900 and small dots represent locations where plants were obtained since 1900. It appears that the species has spread away from the canal system since 1900.

biscus moscheutos, Nelumbo lutea, Heteranthera reniformis, and *Najas guadalupensis*. The plants which have spread southward via the canal system are largely submersed species or shoreline species which are characteristically associated with lakes. Those species which have migrated northward more commonly occur on mudflats or in riparian habitats and are usually associated with rivers. It is probable that additional species, particularly in the latter group, may have become so ubiquitous through time that their present distributions can not be recognizably related to canal routes.

The seed bank may have an important role in maintaining isolated populations of plants in remnant canal habitats. Of the 12 flowering plant species listed above, 5 are annual and 11 are prolific seed producers (*Potamogeton richardsonii* produces fruits infrequently in Ohio). Species with tendencies to spread vegetatively are proportionally underrepresented. At some sites where we have made repeated observations, species have periodically disappeared and reappeared as a result of changes in local habitat conditions. The decline of the canal system and resultant unpredictability of the water supply appears to have favored those species able to persist as seed bank fugitives.

The initial introduction of a species into a new geographic area may result in "explosive" changes in abundance, floristic composition, and local distribution (Sculthorpe 1967; Aron and Smith 1971). Several such changes have been documented for European wetland plants that now occur in Ohio such as *Lythrum salicaria* (Stuckey 1980; Thompson et al. 1987), *Typha angustifolia* (Stuckey and Solamon 1987, *Butomus umbellatus* (Boutwell 1990), and *Epilobium hirsutum* (Stuckey 1970). Invading species often become naturalized and then decline in abundance. At a later time they may appear as if to be a part of the indigenous flora. Expansions involving species at the edge of their natural geographical ranges, after 150 years of establishment and further spread, are difficult to document today. Historical explanations can nevertheless help explain isolated populations of organisms and anomalous distribution patterns.

ACKNOWLEDGMENTS

We thank Mr. Allison W. Cusick for supplying records of several taxa from data at the Ohio Department of Natural Resources; Dr. Shirley Graham who supplied data from herbarium specimens used in making the major portion of the distribution map of *Ammannia robusta* in the United States; Dr. Robert R. Haynes for identifications and distributional records of *Najas;* Mr. A. E. Spreitzer for preparing the photographs for publication; Mr. Ray Jezerinak for comments on the manuscript; and Mr. John M. Roberts for assistance with field studies.

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Bartonia No. 57: 75–81, 1992

The Flora of Bennett Bogs Preserve: Past and Present

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The Bennett Bogs Preserve is a land holding of the New Jersey Audubon Society and The Nature Conservancy. It is located southeast of the intersection of Shunpike and Tabernacle Road, in Lower Township, Cape May County. The ±28 acre (±11 hectare) site consists of a series of intermittent pond communities and adjacent woodland (See Fig. 1). To determine the present flora in the Preserve, field investigations were done from the summer of 1988 through the fall of 1990.

SITE DESCRIPTION

The Preserve is located in the Outer Coastal Plain physiographic region of New Jersey and is underlain by soils composed of sand, gravel, and clay, typically classified as Sassafras (Cape May Phase) soils. The pond habitats are underlain by a very poorly drained soil type, Pocomoke sandy loam, while the remainder of the site, covered by woodlands, is underlain by a moderately well drained to somewhat poorly drained Hammonton sandy loam or a well drained Sassafras sandy loam (SCS 1977).

The climate of the area is as follows (Montgomery and Fairbrothers 1963):Mean Annual Temperature–54°F (12°C); Maximum Temperature–100°F (38°C); Minimum Temperature–3°F (−19°C); Mean Annual Precipitation–45 in (114 cm); Frost Free Days–225 days. The greatest amount of rain falls in July and August, while the driest period occurs from September through November (Brown and Wherry 1970).

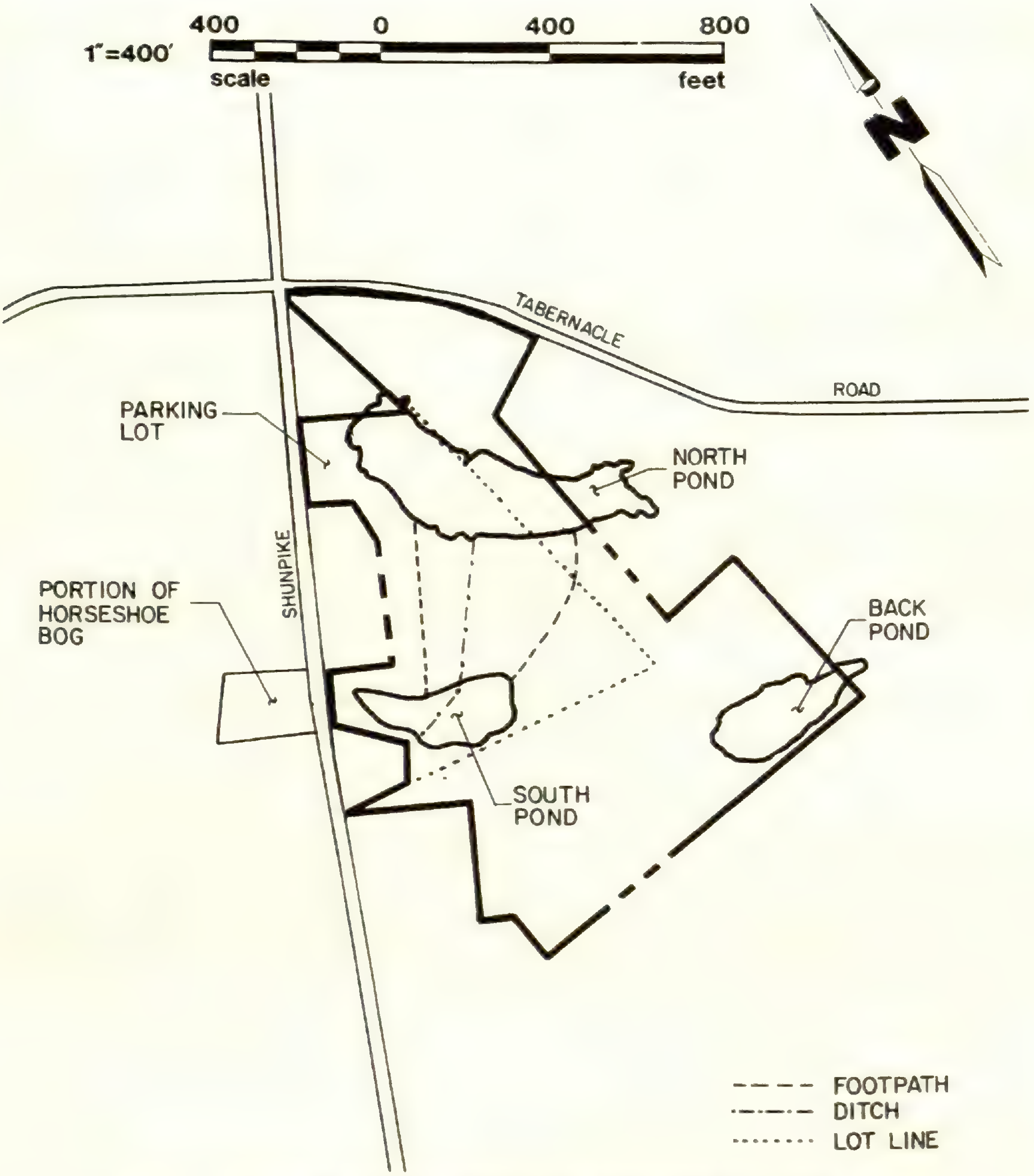
Due to the seasonally high water table found in Pocomoke soils and the presence of clay fragipans (soil horizons very slowly permeable to water), the pond habitats contain water for at least a part of the year. The surrounding woodland, however, does not contain these fragipans and, therefore, does not have any standing water under normal circumstances. The water level within the ponds varies from season to season as well as from year to year.

This area was selected for study because of its unusual floristics as noted by Alexander (1951), Brown (1946), Brown and Wherry (1970), Long (1907 and 1911), Montgomery and Fairbrothers (1963), Montgomery (1963), Stone (1907, 1908, 1909, and 1911), and Wherry (1954 and 1963).

METHODOLOGY

In order to construct a historical list of the flora observed within Bennett Bogs Preserve, it was necessary to do a literature search of pertinent botanical journals and reports. A master list was created using Witmer Stone's Plants of Southern New Jersey. Any species listed from the location "Bennett" was recorded as a possibility. Through the use of the reports mentioned earlier, the herbarium of the Academy of Natural Sciences, and advice from other area botanists, additions and/or deletions were made to finalize the historical list found in Appendix A.

Although this field investigation was focused on the land holdings of The Nature Conservancy and New Jersey Audubon, the determination of historical records for the plant species collected in this general area are not as well defined. Best professional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TABERNACLE
ROAD
PARKING LOT
NORTH POND
SHUNPIKE
PORTION OF HORSESHOE BOG
BACK POND
SOUTH POND
FOOTPATH
DITCH
LOT LINE

FIG. 1. Bennett Bogs Preserve. Based on aerial photo taken on 21 March 1987.

judgement was used to determine whether a particular species was collected within the area of the intermittent ponds and their adjacent woodland.

Some species that may have come from Bennetts Bog were not included due to vague locality data. For example, *Galactia volubilis* was collected in the general area but it is not known for sure if it was actually in the study area.

In addition, previous studies have included some misidentifications such as *Waldsteinia fragarioides* (Montgomery and Fairbrothers 1963). Wherry (1963) noted this mistake. This taxon was not included in the present list.

One possible area of confusion in this study is the horseshoe bog, an additional area which exists on the west side of Shunpike which was inventoried in past studies. Since this area is not owned by either NJAS or TNC, it was not formerly considered part of this study. Many species have been collected there in the past. A cursory inventory was conducted during the inventory of the ponds east of Shunpike. Species that were determined to be found there both historically and presently are indicated in the plant list.

Field investigations were conducted from the summer of 1988 through the fall of 1990. Investigations in 1988 and 1990 were infrequent and chosen during opportune times of dry spells. The investigations during 1989 were approximately every two weeks starting in late March and ending in early November.

Investigations utilized a total survey technique to determine the species present. The area was comprehensively searched. The ponds were investigated to a greater degree due to their great diversity. However, this does not infer that the woodlands were not thoroughly investigated.

RESULTS

FLORISTICS. Historically, 271 taxa of vascular flora from 66 families were known to occur at this site. This includes 11 pteridophytes, 2 gymnosperms, and 258 angiosperms. The Poaceae had the largest number of taxa present historically with 37. The Cyperaceae had 36, the Asteraceae had 33, and the Orchidaceae had 13 taxa. The genus *Rhynchospora* had the most species present with 10. *Eleocharis* was second with 8 species, and *Dichanthelium* had 7 taxa. *Eupatorium* and *Juncus* each had 6 taxa represented. See Appendix A.

The field investigations of this study found 153 taxa of vascular flora present at the Preserve site (See Appendix A). The species were in 57 families of higher plants. This included 7 taxa of pteridophytes, 2 taxa of gymnosperms, and 144 taxa of angiosperms. The Poaceae had 23 taxa present and the Cyperaceae had 17 species. The Ericaceae and the Asteraceae were next with 11 species each. *Eleocharis* was the largest genus with 7 species present. *Hypericum, Dichanthelium,* and *Panicum* each had 4 taxa.

CHARACTERISTICS OF THE VEGETATION. *Pond communities.* Each of the three ponds differ in their vegetation cover, although all are dominated by herbaceous plants. The western section of the north pond is dominated by *Glyceria obtusa, Carex vescaria* var. *monile,* and *Calamagrostis canadensis.* Due to changes in the hydrologic regime, *Acer rubrum, Liquidambar styraciflua, Cephalanthus occidentalis,* and *Diospyros virginiana* are invading the central and northern sections of the north pond. In the southcentral portion of the north pond, there exists a small cove area dominated by *Muhlenbergia torreyana* and *Gentiana autumnalis.* In addition, there exists an area in the central section of the site which is dominated by *Eleocharis quadragulata* and *Cladium mariscoides.* The south pond is greatly influenced by *Panicum hemitomon* and this species dominates most of the pond. A small area exists in the eastern section of the pond which recently was dominated by *Cladium mariscoides* and *Eleocharis melanocarpa.* The back pond differs in physical characteristics to the other two ponds in that it contains a more well developed peat layer and has deeper sections which pond water longer. The dominant vegetation has varied greater than the other ponds. In 1988 and 1989, it was dominated by *Dichanthelium acuminatum* var. *densiflorum* (*Panicum spretum*) and *Juncus canadensis.* However, in 1990, *Rhynchospora chalarocephala* and *Rhynchospora macrostachya* became the dominants throughout the pond. In the central section of the back pond, there exists a patch of *Eleocharis quadragulata.* In addition, woody species such as *Diospyros virginiana, Acer rubrum,* and *Liquidambar styraciflua* form a ring of vegetation adjacent to the woodlands surrounding the pond.

Woodland communities. Pitch pine (*Pinus rigida*) dominates most of woodland of the site. In wetland areas adjacent to the ponds, red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*) co-dominate with pitch pine. Also in these wetland areas, the shrub layer is made-up of sweet pepperbush (*Clethra alnifolia*) and highbush blueberry (*Vaccinium corymbosum*). Of interest in the herbaceous layer is the cranefly orchid (*Tipularia discolor*).

The upland woodlands found on the site are dominated by white oak (*Quercus alba*), American holly (*Ilex opaca*) and, to a lesser extent, pitch pine (*Pinus rigida*). The shrub layer is composed of black huckleberry (*Gaylussacia baccata*) and scattered lowbush blueberry (*Vaccinium pallidum*). The herbaceous layer contains cow-wheat (*Melampyrum lineare*), partridge berry (*Mitchella repens*), and pink ladyslipper (*Cypripedium acaule*).

Discussion

REDUCTION OF DIVERSITY. There is a significant reduction in the diversity of species from the past to the present flora. The following factors may be responsible for this.

The EPA (1989) states that the known or potential threats to Bennetts Bog are that it is "surrounded by development. Threatened by subsequent disturbance, pollution, and alteration of water quality and the water table. Subject to pesticide applications." Johnson (pers. comm.) has also stated that the local mosquito commission has sprayed the back pond which is adjacent to a private camping area. This spraying and the use of all terrain vehicles may also have had an impact on the site.

Another factor which may be adversely affecting the species composition is the natural phenomena of succession linked with a change in the natural hydrological cycle. If the hydrological regime is disrupted and the site is not flooded as regularly, woody vegetation such as persimmon, red maple, and sweetgum will invade and convert these herbaceous communities into forested communities. In fact, that type of invasion is observable now in the North Pond by the species mentioned.

Another type of succession influences these habitats. The growth habit of certain herbaceous species such as maidencane, *Panicum hemitomom,* is such that large areas can be covered by clonal mats of this species. These dense stands out-compete other species. It has, also, been found that maidencane is tolerant to flooding. The South Pond is an example of this. Other species able to do this in these communities are blue-joint grass, *Calamagrostis canadensis,* and common reed, *Phragmites australis.* These two species are present in the North Pond and may influence the community structure and composition.

MANAGEMENT. The most important management issue in attempting to preserve the species diversity and the species assemblages is the maintenance of the herbaceous stage of these ponds. Since there is no way to control the hydrologic regime in these habitats, the control of woody vegetation must be by physical means. Mowing of woody vegetation must be done during the winter or early spring when conditions permit. Physical removal of woody vegetation by hand would also be useful and could be done at any time of year. Continually removing new sprouts of the invading trees and shrubs should cause their eventual demise.

While it would be nearly impossible to return the site to its original configuration hydrologically, ditches constructed in the past should be blocked up, even only on a temporary basis to determine its effect.

ACKNOWLEDGMENTS

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APPENDIX A

Historical List of Vascular Plant Species Found at Bennett Bogs

The nomenclature used in this list for the flowering species is taken from Kartesz and Kartesz (1980). Familial names for flowering species are adopted from Cronquist (1981). The nomenclature for the families and species of pteridophytes is in accordance with Lellinger (1985). Symbols and abbreviations are defined as follows: *–species seen between 1988 and 1990. ?–species seen in recent past and needing additional investigation. Some could be extirpated. U bog–plant species found only in "horseshoe bog" west of Shun pike and not owned by NJAS or TNC. PH–taxa vouchered at the herbarium of the Academy of Natural Sciences. CHRB–

taxa vouchered at the Chrysler Herbarium at Rutgers University, Bush Campus. NY–taxa vouchered at the herbarium of the New York Botanical Garden. GH–taxa vouchered at the herbarium of Harvard University.

Pteridophytes

Blechnaceae: *Woodwardia areolata,* virginica.**

Dennstaedtiaceae: *Pteridium aquilinum.**

Isoetaceae: *Isoetes melanopoda?* PH.

Lycopodiaceae: *Lycopodium alopecuroides?* PH, *appressum** PH, *carolinianum?* PH, × *copelandii* (*alopecuroides* × *appressum*)? PH.

Osmundaceae: *Osmunda cinnamomea,* regalis* var. *spectabilis.**

Thelypteridaceae: *Thelypteris palustris* var. *pubescens.**

Gymnosperms

Cupressaceae: *Juniperus virginiana.**

Pinaceae: *Pinus rigida.**

Angiosperms

Class Magnoliopsida

Aceraceae: *Acer rubrum.**

Anacardiaceae: *Rhus copallina* U bog;* *Toxicodendron radicans,* vernix?.*

Apiaceae: *Centella erecta?* PH; *Cicuta maculata** PH; *Eryngium aquaticum** PH; *Hydrocotyle umbellata;* Sium suave.**

Aquifoliaceae: *Ilex glabra** PH, *laevigata?, opaca,* verticillata?* PH.

Asclepiadaceae: *Asclepias incarnata* ssp. *pulchra* U bog.

Asteraceae: *Antennaria plantaginifolia* var. *arnoglossa* (*A. parlinii*) U bog; *Aster dumosus,* novi-belgii* (incl. var. *elodes*),* *pilosus* var. *demotus* U bog, *vimineus* U bog PH; *Bidens connata,* discoidea?* PH, *frondosa?; Boltonia asteroides** PH; *Chrysopsis mariana* U bog PH; *Cirsium horridulum* U bog, *virginianum?* NY; *Erechtites hieracifolia* U bog; *Eupatorium dubium* U bog, *leucolepis** PH, *perfoliatum* U bog, *rotundifolium* var. *ovatum* (*E. pubescens*) U bog, *rotundifolium* var. *saundersii* U bog PH, *serotinum?; Euthamia graminifolia,* tenuifolia** PH; *Gnaphalium obtusifolium* U bog PH; *Hieracium gronovii* U bog; *Hypochoeris radicata* U bog; *Pluchea foetida* U bog; *Prenanthes trifoliata* U bog; *Sclerolepis uniflora** PH; *Senecio tomentosa* U bog PH; *Solidago canadensis* var. *scabra* U bog, *latissimifolia* (*S. elliottii*) U bog PH, *fistulosa* U bog* PH, *puberula* U bog* PH, *rugosa* var. *aspera* U bog.*

Callitrichaceae: *Callitriche heterophylla.**

Campanulaceae: *Lobelia nuttallii** PH, *puberula* U bog* PH, *spicata?.*

Caprifoliaceae: *Viburnum dentatum,* nudum?* PH.

Clethraceae: *Clethra alnifolia** PH.

Clusiaceae: *Hypericum adpressum** PH, *boreale* or *Hypericum mutilum?, canadense** PH, *denticulatum** PH; *Triadenum virginicum.**

Convolvulaceae: *Ipomoea pandurata* U bog.

Cornaceae: *Cornus florida.**

Cuscutaceae: *Cuscuta compacta?.*

Droseraceae: *Drosera intermedia.**

Ebenaceae: *Diospyros virginiana.**

Ericaceae: *Gaultheria procumbens;* Gaylussacia baccata,* frondosa;* Kalmia angustifolia;* Leucothoe racemosa;* Lyonia ligustrina* U bog, *mariana;* Rhododendron periclymenoides,* viscosum;* Vaccinium corymbosum* (incl. *V. caesariense*),* *macrocarpon** PH, *pallidum* (*V. vacillans*).*

Fabaceae: *Apios americana** PH; *Cassia fasciculata* U bog* PH; *Lespedeza capitata* U bog.

Fagaceae: *Quercus alba,* coccinea,* falcata,* phellos** PH.

Gentianaceae: *Bartonia paniculata?* PH, *virginica?* PH; *Gentiana autumnalis* some planted* PH, *saponaria* U bog* PH; *Sabatia difformis.**

Geraniaceae: *Geranium molle.**

Haloragaceae: *Prosperpinaca pectinata** PH, *palustris** PH.

Hamamelidaceae: *Liquidambar styraciflua.**

Juglandaceae: *Carya tomentosa.**

Lamiaceae: *Lycopus americanus* U bog, *amplectans,* rubellus?, uniflorus?; Scutellaria integrifolia* U bog PH.

Lauraceae: *Sassafras albidum.**

Lentibulariaceae: _Utricularia geminiscapa,_* _gibba?, radiata_* PH, _juncea?_ PH, _subulata?_ PH.

Linaceae: _Linum intercursum?, striatum?_ PH.

Magnoliaceae: _Magnolia virginiana._*

Melastomataceae: _Rhexia mariana_ U bog PH, _virginica_* PH.

Monotropaceae: _Monotropa uniflora._*

Myricaceae: _Myrica cerifera_* PH, _pensylvanica?._

Nymphaeaceae: _Nuphar lutea;_* _Nymphaea odorata._*

Nyssaceae: _Nyssa sylvatica._*

Onagraceae: _Ludwigia alternifolia_ U bog, _hirtella?_ PH, _sphaerocarpa_* PH; _Oenothera biennis_ U bog.

Polygalaceae: _Polygala cruciata_* PH, _lutea?, mariana?_ PH, _ramosa?_ PH.

Polygonaceae: _Polygonum amphibium_ var. _emersum_ (_P. coccineum_)* PH, _hydropiperoides,_* _pensylvanicum_ U bog PH, _punctatum_ U bog; _Rumex crispus._*

Primulaceae: _Lysimachia hybrida?_ PH; _Trientalis borealis._*

Pyrolaceae: _Chimaphila maculata._*

Rosaceae: _Amelanchier canadensis?;_* _Aronia arbutifolia_* PH; _Prunus serotina;_* _Rosa multiflora,_* _palustris,_* _Rubus_ sp.?.*

Rubiaceae: _Cephalanthus occidentalis;_* _Galium tinctorium_* PH; _Mitchella repens._*

Salicaceae: _Salix nigra,_* _Salix_ sp.?.*

Santalaceae: _Commandra umbellata_ U bog.

Scrophulariaceae: _Agalinis purpurea_ U bog; _Gratiola virginiana?_ PH, _pilosa_ U bog; _Melampyrum lineare._*

Violaceae: _Viola lanceolata_* PH.

Vitaceae: _Parthenocissus quinquefolia_* PH.

Class Liliopsida

Alismataceae _Alisma plantago-aquatica_ var. _parviflorum_ (_A. subcordatum_)* PH; _Sagittaria graminea?._

Cyperaceae: _Carex albolutescens?, lupulina?, lurida,_* _vesicaria_ var. _monile;_* _Cladium mariscoides_* PH; _Cyperus filiculmis?, polystachios?_ PH, _refractus?_ CHRB, _retrorsus?, strigosus_ U bog; _Dulichium arundinaceum;_* _Eleocharis brittonii?_ PH, _melanocarpa_* PH, _microcarpa_* PH, _olivacea,_* _quadrangulata_* PH, _palustris,_* _tenuis,_* _tuberculosa_* PH; _Fimbristylis autumnalis_* PH; _Fuirena pumila_ U bog PH; _Psilocarya nitens?_ PH; _Rhynchospora capitellata?_ PH, _chalarocephala_* PH, _filifolia?_ PH, _fusca_* PH, _globularis_ (_R. cymosa_)?, _glomerata?_ PH, _gracilenta?_ PH, _macrostachya_* PH, _rariflora?_ PH, _torreyana?_ PH; _Scirpus cyperinus_* PH; _Scleria minor?_ PH, _pauciflora?, reticularis._*

Eriocaulaceae: _Eriocaulon compressum?_ PH.

Haemodoraceae: _Lachnanthes caroliana_* PH.

Iridaceae: _Sisyrinchium angustifolium?, atlanticum._*

Juncaceae: _Juncus acuminatus,_* _canadensis_* PH, _dichotomus?_ PH, _effusus,_* _marginatus_ var. _odoratus_ (_J. biflorus_)?, _scirpoides?_ PH.

Liliaceae: _Aletris farinosa_ U bog? PH.

Orchidaceae: _Cleistes divaricata?_ PH; _Cypripedium acaule;_* _Isotria verticillata?; Platanthera_ × _bicolor_ (_P. blephariglottis_ × _ciliaris_) U bog? PH, _blephariglottis?_ still in U bog,* _ciliaris_ U bog? PH, _integra_ (planted in ponds)?, _lacera?, nivea_* PH; _Pogonia ophioglossoides?; Spiranthes cernua?_ PH, _laciniata_ (may have been misidentified formerly as _S. praecox_)? PH; _Tipularia discolor._*

Poaceae: _Agrostis canina,_* _perennans?; Amphicarpum purshii?_ PH; _Andropogon elliottii?, glomeratus?_ PH, _virginicus_* PH; _Aristida virgata?_ PH; _Calamagrostis canadensis_* PH, _cinnoides_* PH; _Chasmanthium laxum;_* _Coelorachis rugosa_ (_Manisuris r._)* PH; _Dichanthelium aciculare?_ PH, _acuminatum_ var. _densiflorum_ (_Panicum spretum_)* PH, _acuminatum_ var. _wrightianum_ (_Panicum wrightianum_)* PH, _clandestinum,_* _oligosanthes?, scoparium_* PH, _sphaerocarpon_ var. _isophyllum_ (_Panicum polyanthes_)? PH; _Glyceria obtusa_* PH, _septentrionalis_* PH; _Gymnopogon brevifolius?_ PH; _Holcus lanatus_ U bog; _Leersia oryzoides,_* _Muhlenbergia torreyana_* PH, _uniflora?; Panicum dichotomiflorum?, hemitomon_* PH, _rigidulum_ (_P. longifolium_ Torr.)* PH, _verrucosum_* PH, _virgatum;_* _Paspalum dissectum?_ PH, _floridanum_ var. _glabratum_ U bog* PH, _laeve_ U bog PH; _Phragmites australis_* _Torreyochloa pallida_ (_Glyceria pallida_);* _Tridens flavus_ U bog;* _Tripsacum dactyloides_ U bog.*

Potamogetonaceae: _Potamogeton diversifolius?, pulcher?._

Smilacaceae: _Smilax glauca,_* _herbacea,_* _pseudo-china?_ PH, _rotundifolia._*

Xyridaceae: _Xyris difformis?_ PH, _jupicai?_ GH, _smalliana_* PH, _torta?._

Bartonia No. 57: 82–94, 1992

A Short History of the William Darlington Herbarium with an Annotated List of Plant Collectors Represented

WILLIAM R. OVERLEASE
1645 Sycamore Court, Bloomington, IN 47401

The Darlington Herbarium at West Chester University, West Chester, Pennsylvania, contains approximately 17,000 plant specimens from such diverse regions as Arctic America, Siberia, Palistine, South Africa, Australia, Jamaica, the British Isles, France, Germany, Italy, and Egypt.

The earliest dated specimen was collected by Dr. William Darlington in 1810; however, the majority were collected from 1826 to 1850. It represents the herbarium of the Chester County Cabinet of Natural Science founded in 1826. Dr. Darlington always referred to it as the Cabinet Herbarium though today we refer to it as the Darlington Herbarium. His own specimens in the collection number about 4,100. David Townsend, who worked closely with Dr. Darlington in collecting Chester County plants is represented by approximately 2,200 specimens. These collections formed the basis for Darlington's two floras of Chester County in 1837 and 1853 (Darlington 1837, 1853).

Plants from over 270 collectors are found in the herbarium. Of special interest are the botanist-explorers of the 1820–1860 period of national expansion and exploration. Some of the more famous represented include Captain John Fremont, Thomas Nuttall, Dr. William Baldwin, Sir John Franklin (the arctic explorer), and one specimen grown from plants brought back by the Lewis and Clark expedition. Other active botanists of this period are also well represented: C. W. Short, George Englemann, Sir William Hooker, I. A. Lapham, T. G. Lea, John Torrey, Lewis David von Schweinitz, M. A. Curtis, Dr. Samuel Freedly, J. G. Agardh, Edward Tuckerman, Jr., and Jacob Wolle.

Two of the most interesting collections are from the gardens of John Bartram of Philadelphia, collected between 1818 and 1861, and Humphry Marshall of Chester County, Pennsylvania, collected from 1819 to 1851. John Bartram's garden is generally regarded as the first botanical garden in the colonies and that of Humphry Marshall as the second devoted to native plants. Specimens from the Peirce Brother's estate in Chester County, now part of Longwood Gardens, are also of special historical interest (Roberts 1971).

Two important special collections are represented by Professor William Harvey's collection of algae from the Great Barrier Reef of Australia (Gordon 1975) and Ezra Michener's early collection of Chester County lichens, published in Darlington's *Flora Cestrica,* 1853.

Among the important contributors to the herbarium was Elias Durand, curator of the herbarium of the Academy of Natural Sciences of Philadelphia (2,370 specimens). His contributions represent plants he collected personally and those received by exchange. His most important contribution, which is of considerable interest to botanists in taxonomic work today, is the plants he found in the herbarium of the controversial C. S. Rafinesque. These include 40 specimen with original labels from Rafinesque's *Autikon Botanikon* and 263 specimen from his personal herbarium obtained by Durand when Rafinesque died in poverty in Philadelphia in 1840 (Overlease and Rofini 1987).

Though his earliest specimen is dated 1810, Dr. Darlington began collecting for his personal herbarium in 1817 (Overlease 1966). The bulk of his collecting however was done from 1826 to about 1835. The Chester County Cabinet of Natural Science herbarium was established in 1826 making it the second oldest institutional herbarium in the United States (Gordon 1952). When the Chester County Cabinet became inactive, the herbarium became the property of the West Chester Academy in 1850. It was transfered to the West Chester Normal School, now West Chester University, in 1871.

In Darlington's day the individual plants were stored loose in folded paper. Eric Pennell (undated manuscript) reports that sometime after 1885 and prior to the turn of the century, the entire herbarium was remounted and cleaned. Pennell also reports that in the 1920s under the direction of Dr. Carlos B. Cochran, head of the Science Department, the specimens were mounted and glued on herbarium sheets by Francis Windle. Occasionally, to save paper, as many as five specimens of a single species from different localities and collectors were mounted on a single herbarium sheet.

In 1935–36, Walter J. Nickerson, Jr., an undergraduate student at West Chester, reviewed some of the specimens in the herbarium, especially the grasses, and wrote notes on the herbarium sheets concerning the nomenclature.

The herbarium was originally housed at the Normal School in tall wooden cases. In 1941, Dr. Robert B. Gordon of the science department obtained steel fire-proof cabinets for the collection now in Schmucker Science Center, West Chester University.

In 1943, the late Dr. Robert B. Gordon published a summary of many of the collectors represented in the herbarium (Gordon 1943). This summary was based on a hand written catalog of plants in the herbarium in 1843 by Dr. Darlington. The data was compiled by Eric Pennell, a student at the college.

In 1965, under the direction of Dr. William Overlease, new genus covers were made to the herbarium and the collection arranged alphabetically by family and alphabetically by genus within each family.

Plants of special interest such as the Fremont material, specimens from John Bartram's and Humphry Marshall's gardens, and specimens of C. S. Rafinesque, Dr. William Baldwin, Thomas Nuttall, and Sir John Franklin were brought together as special collections. A file of authenticated botanist's handwriting based on letters and notes found on herbarium specimens was established. Identified type specimens were segregated.

At the recommendation of Dr. Ronald L. Stuckey of Ohio State University, a file card for each herbarium specimen was typed and filed under the name of the collector. This was a five year project completed by student help and involved over 17,000 file cards. It is now possible to review the contributions of each of the over 270 collectors without having to search through the herbarium. Among the students that made very special contributions were Richard Casson, Dennis Bartow, Eileen Seaker, and Diane Rofini. Many other students made fine contributions to the work over the years.

In the Fall of 1969, Dr. Joseph Ewan of Tulane University, as a consultant on the herbarium, gave many useful suggestions for possible future development of the materials.

Present inquiries regarding the herbarium should be directed to Dr. Martha Potvin, Curator, Darlington Herbarium, Biology Department, West Chester University, West Chester, PA 19383.

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Besides the work of many interested undergraduate and graduate students at West Chester University, the gracious support of the late Dr. Robert B. Gordon, and the stimulating ideas of Dorothy I. Lansing, M.D., the biographer of Dr. William Darlington, I wish to thank Dr. Joseph Ewan and Dr. Ronald Stuckey for their many useful and important suggestions over the many years. Also Rosemary B. Philips, librarian of the Chester County Historical Society and her staff for their considerable help on local collectors.

COLLECTORS AND NUMBER OF COLLECTIONS REPRESENTED IN THE DARLINGTON HERBARIUM

The following is an alphabetical listing of plant collectors represented in the Darlington herbarium and the number of collections for each. The collectors are grouped by the primary geographical region of their collections. More complete biographical summaries for each of the major collectors will be found in the herbarium. These were developed by two graduate students, Eileen Seeker and Diane Rofini.

COLLECTORS OF EASTERN UNITED STATES

Bartram's Garden: 118. Specimens from John Bartram's Garden by several collectors, especially John B. Carr (see below), between 1818 and 1861. Specimens housed separately.

Beck, Dr. Romayne, 1791–1855: 2. Physician, botanist of New York region. Specimens coll. Beck and Torrey in 1827 and 1839.

Bigelow, Dr. Jacob, 1786–1879: 2. Physician, professor of materia medica at Harvard Medical School, botanist.

Brace, John, 1793–1872: 190. Educator, editor, botanist, Connecticut.

Carey, John, 1797–1880: 15. English botanist who came to the New York area. He was of considerable help to Asa Gray in the clear, crisp, businesslike prose which distinguishes Gray's *Elements of Botany*.

Cooper, William, 1797–1864: 22. A founding member of the New York Lyceum of Natural History, New York area.

Dix, Dorothea Lynde, 1802–1887: 4. Nationally known advocate for mentally ill treatment. Superintendent of Army nurses during the Civil War.

Eaton, Amos, 1776–1842: 9. American naturalist, botanist, professor Rensselaer Scientific School. His *Manual of Botany* went through eight editions from 1817 to 1840 and was the field reference book for every botany student in higher schools and academies of the time.

Eaton and Torrey: 3. See Amos Eaton and John Torrey.

Gray, Dr. Asa, 1810–1888: 21. Professor of Natural History at Harvard University. Dominated American botany for nearly 50 years. His *Manual of the Flora of Northern United States* (1848) and its many revisions became a standard for field identification in the region.

Gray, Asa and J. Carey: 8. Mountains of Carolina, 1841. See John Carey above.

Marshall, Humphry, 1722–1801: 55. Specimens collected from his botanical garden from 1819 to 1851 by several collectors. These specimens are brought together in a special collection in the herbarium. He is often credited with publishing the first book on American botany by an American, *Arbustum Americanum: The American Grove* (1785). His home and garden are in Chester County, Pennsylvania.

Muhlenberg, Gotthilf Heindrich Ernst, 1753–1815: 1. One of America's outstanding early botanists. Minister, botanist, Lancaster, PA.

Perceval, Anne Mary, 1790–1876. Leather bound book in the herbarium with about 50 pp. of mounted specimens. Titled *Specimens Canadian Plants 1826*. One of the early plant collectors of Canadian plants. She was the daughter of Sir Charles Flower, Lord Mayor of London. Came to Canada in 1810. She returned to Britain in 1829. She also sent specimens to Sir William Hooker, John Torrey, and Schweinitz.

Pickering, Dr. Charles, 1805–1878: 53. Physician, botanist, naturalist, explorer, member of Wilkes Exploring Expedition (1836–1842), Philadelphia.

Porter, Jacob, 1783–1846: 50. Physician, local plant collector, Massachusetts. Specimens from 1833–1846. Sent 48 plant specimen to Chester County Cabinet of Natural Science in 1833.

Potter: 2. Mr. Potter, Rhode Island. Sent two specimens of June Grass to J.L.D. (J. Lacey Darlington) probably in his role as editor of *Farm Journal,* West Chester.

Rich, William, 1800–1864: 11. Horticulturist, botanist on Wilkes Exploring Expedition (1838–1842), Washington, DC.

Schweinitz, Lewis David Von, 1780–1834: 435. Minister, botanist, especially fungi. Collections in herbarium mostly eastern Pennsylvania. An outstanding early American scientist.

Torrey, Dr. John, 1796–1873: 268. Botanist, scientist, New York. One of the most active and influential botanists in America. Worked on botany of exploring expeditions and the western railroad surveys. The Captain John Fremont specimens in the herbarium were sent by Dr. Torrey.

Torrey and Gray: 16. John Torrey and Asa Gray. See Asa Gray above. Specimens with *Flora North America* labels.

Tuckerman, Edward, Jr., 1817–1886: 258. Minister, professor of botany, Amherst College, specialist on lichens. Included are many specimens from the White Mountains.

Collectors of Southern United States

Affleck, Thomas, 1812–1868: 27. Horticulturist, farmer, businessman. Came to U.S. from Scotland in 1832. Junior editor of *The Western Farmer and Gardner* in Cincinnati, Ohio. Moved to Washington, Mississippi in 1842 where he established one of the first commercial nurseries in the south. He was one of the early advocates of diversified farming in the Southern States. Collections from Mississippi.

Baldwin, Dr. William, 1779–1819: 112. Physician, botanist. Died while serving as surgeon-botanist on the Major Stephen Long expedition up the Missouri River in 1819. Most of the herbarium collections are from Georgia and Florida. The following note is attached to a specimen *Rudbeckia triloba,* "Aug. 8, 1819, Franklin" "This appears to have been the last plant that poor Baldwin collected. The last date in his journal is Aug. 8, 1819" signed J.T. (John Torrey). Dr. Baldwin was a close personal friend of Dr. William Darlington who after his death collected his botanical letters and had them published as *Reliquiae Baldwinianae* in 1843. His specimens are housed separately in the herbarium.

Boykin, Dr. Samuel, 1786–1848: 1. Milledgeville, Georgia.

Buckley, Samuel Botsford, 1809–1884: 160. Geologist, botanist. Mostly Alabama plants with some specimens from Georgia and Illinois.

Carraway, Dr. I. S.: 1. Mississippi, 1833.

Chapman, Dr. Alvan Wentworth, 1809–1899: 3. Physician, botanist. 57 specimens were presented to the Chester County Cabinet of Natural Science Herbarium from Dr. Alvan Wentworth Chapman by Halliday Jackson in 1861. See LOCAL COLLECTORS, Halliday Jackson.

Croom, Hardy Bryan, 1799–1837: 2. Lawyer, plant collector, explorer. Died at sea. Published with Dr. H. Loomis "Plants of New Bern, North Carolina."

Curtis, Moses Ashley, 1808–1872: 833. Minister, botanist, mycologist. North Carolina.

Dorn, Dr.: 34. Greenwood, Abbeyville, South Carolina.

Eaton, Dr. (Possibly Alvah Augustus Eaton, 1865–1908): 3. This more recent collection may have been added to Darlington collection in later years. Florida specimens.

Elliott, Stephen, 1771–1830: 46. Banker, botanist, professor of botany and natural history at Medical College of South Carolina.

Gates, Dr. Hezekiah, d. 1850?: 53. Plant collector commissioned by Dr. John Torrey for Alabama collections.

Hale, Dr. Josiah, 1791–1856: 6. Louisiana, Two specimens through E. Durand to Darlington, three through C. W. Short to Darlington.

Johnson, Miss Emily: 1. Charlestown, South Carolina in 1852.

Kate, L. D.: 2. Yorktown, Virginia in 1849.

Loomis, Dr. H. and H. B. Croom: 2. Newberry, North Carolina. See H. B. Croom above.

Peck, Dr. Clarendon, 1812–1837: 1. Physician of Sicily Island, Catahoula Parish, LA, 1833–1837. Correspondent of C. W. Short of Kentucky. Specimen of *Utricularia fornicata* LeConte.

Porter, Thomas Conrad, 1822–1901: 62. Professor at Marshall College and Lafayette College. One-half of specimens from Georgia.

Read, James, ?–ca. 1857: 77. 1836 Chester County Cabinet of Natural Science report, "105 plants from Georgia and Florida by James Read by way of Dr. Carson" (of Philadelphia). See LOCAL COLLECTORS.

Riddell, Dr. John Leonard, 1807–1865: 123. Physician, botanist, inventor, professor at Medical College of Louisiana (later Tulane University). Louisiana.

Smith, Mrs. Ann E.: 91. Wife of Dr. Thomas Lacey Smith, one of Dr. William Darlington's medical students. Georgia.

Smith, Dr.: 1. Probably Dr. Thomas Lacey Smith, 1805–1875. Noted above. Physician, member of Indiana Supreme Court, 1853. Specimen from Georgia.

Steinhauer, Daniel, 1785–1852: 34. Born in Wales. Teacher in Moravian schools in Pennsylvania, Ohio, and Louisiana.

Terrell, Dr. G. F.: 2. Virginia, one dated 1852.

Walters, Dr.: 1. Southern States, through John Torrey, *Houstonia*. Probably Dr. John H. Walters of St. Louis, one of the founding members of the St. Louis Academy of Science in 1856.

Wilcox: 1. Louisiana. *Justicia* "I cannot yet make out what Endlicher has done with Justicia."

Collectors of Western United States

Buchanan, Robert, 1797–1879: 1. Businessman, horticulturist, Ohio.

Butler, Dr.: 1. Texas, through C. W. Short of Kentucky.

Butter, Jos.: 1. Starke County, Ohio, 1837.

Darlington, J. Lacy, 1809–1893: 78. Son of Dr. William Darlington West Chester, PA. Collected in Indiana and prairies of Illinois, 1835.

Engelmann, Dr. George, 1809–1884: 63. Physician, botanist, first director of Mr. Shaw's Garden, opened to public in 1860, later to become the Missouri Botanical Garden, St. Louis, Missouri.

Fremont, Captain John, 1813–1890: 91. Western explorer, geographer, led several expeditions to the West, rose to rank of Major General during the Civil War. Republican candidate for the President of the United States, 1856. Known as the "Pathfinder to the West." 5 specimens from 1843–44 expedition, 86 from 1845–47 expedition. Sent to Darlington by John Torrey. See Torrey above. Specimens housed separately in herbarium.

Flanner, H. B., 1820–1863: 28. Educator, botanist, Ohio and Missouri. Moved to Dent County, Missouri in the fall of 1856. Taught school and bought land with the expectation of founding a University. He lost his property and all his possessions in an invasion by Morgan's Raiders during the Civil War. He returned to Ohio and died in 1863.

Gambel, Dr. William, 1826–1849: 2. Physician, professor of materia medica at Medical College of the Pacific. He died on his way to the California gold fields in 1849.

Geyer, Carl A., 1809–1853: 10. Horticulturalist, plant collector, sent west to collect plants by George Engelmann and Asa Gray, defected to the British where many of his plant collections went to Sir William Hooker of Kew.

Harris, Mrs. Sarah C.: 47. Galena, Illinois, Columbiana County, Ohio, Minnesota, 1861.

Lapham, Increase Allen, 1811–1875: 144. Botanist, scientist, educator, one of founders of Wisconsin Academy of Sciences, Arts and Letters, Wisconsin Territory.

Leavenworth, Dr. Melines Conkling, 1796–1862: 6. Plant collector, Texas.

Lea, Thomas Gibson, 1785–1844: 219. Businessman, botanist, Ohio.

Lewis and Clark Expedition, 1804–1806: 1. Specimen of *Symphora* (*Symphoricarpos*) *racemosus* with the following label: "from John Jackson's garden, raised by him from plants brought from the Missouri by Lewis and Clark." Jackson's garden was in Chester County, PA. The specimen is dated Aug. 2, 1818.

Lindheimer, Ferdinand Jakob, 1801–1879: 30. Plant collector, Texas.

Mead, Dr. S. B., 1799–1880: 4. Physician, botanist, first resident collector of Illinois plants.

Miller, Miss D. C.: 4. One specimen from Iowa, three from Falls of St. Anthony.

Muller, Dr. Johann Christoph: 27. Doctor, botanist, schoolmaster, musical composer, Rappite Community, Old Economy, Pennsylvania. Specimens Economy and Wabash (Indiana). One specimen dated 1815.

Nicollet and Geyer, Expedition Dakotas: 1. Specimen *Amorpha nana*. Nicollet, Joseph Nicolas, 1786–1843. Astronomer, topographer, explorer. See Carl A. Geyer above.

Nuttall, Thomas, 1786–1859: 25. Botanist, ornithologist, geologist, explorer, Professor and curator of botanic garden at Harvard University. Noted especially for his *Genera of North American Plants* published in 1818. One of America's most outstanding early botanists. Specimens housed separately in the herbarium.

Short, Dr. Charles Wilkens, 1794–1863: 1277. Physician, botanist, professor, Transylvania University, Kentucky. A great plant collector who shared plants with many botanists.

Steinhauer, Daniel, 1785–1852: 34. Born in Wales, teacher in Moravian schools in Pennsylvania, Ohio, and Louisiana.

Watson, Samuel H., 1837–1928: 8. Botanist, teacher, lawyer, a pioneer botanist of southern Wisconsin.

Phelps, Captain J. W., 1813–1885: 37. Graduate of West Point, Brigader General in Civil War, political activist, educator, writer. The 37 specimens are mounted on the original cardboard book size leaves as sent to Dr. William Darlington by Capt. Phelps, 4th Artillery, U.S. Army, 1859. Sent from Camp Floyd, Utah Territ. He was part of the government expedition against the Mormans when he collected the plants.

Collectors of Overseas

Agardh, Georg Jacob, 1813–1901: 472. Swedish botanist, professor of botany, University of Lund.

Baekeler: 1. Germany, through Edward Tuckerman, Jr.

Balfour, J. H., 1808–1884: 1. Professor of botany, University of Edinburgh.

Beauvais et Martins: 23. Switzerland. See Martins below.

Booth, Thomas, 1829–?: 3. Nephew of Thomas Nuttall and adopted son.

Booth and Hooker: 1. See Thomas Booth above. See Sir William Jackson Hooker below.

Boott, Dr. Francis, 1792–1863: 104. Born Boston, MA. Practiced medicine and lectured on botany in England and Scotland.

Brand, William, 1807–1869: 1. Pupil of Robert Graham of Edinburgh.

Bridges, Dr. Robert, ?–1882: 88. Physician, lived in West Chester, PA, in 1850s. Two hort specimens from West Chester. Mostly "Hort Berolin."

Brittinger, Christian Casimir, 1795–1869: 1. Plant taxonomist, Austria.

Bromfield, Dr. William Arnold, 1801–1851: 21. Isle of Wight, England.

Cosson, Ernest-Saint-Charles, 1819–1889: 150. French botanist, member of French Academy.

Cosson and Germain: 314. See Cosson above and Germain below.

De Candolle, Augustin-Pyramus, 1778–1841: 74. Swiss-French botanist. Chair of natural history at University of Geneva.

Dobbin, R. A.: 61. 60 specimens from "Hort Imperial Rio de Janeiro." Newspaper business, *American Newspaper,* Baltimore, MD. The *American Newspaper* for Sept. 21, 1814 gave to the American public the words of the National Anthem "Star Spangled Banner" written only the week before by Francis Scott Key.

Durand, Elias, 1794–1873: 1629. Curator of the herbarium of the Academy of Natural Sciences of Philadelphia. His collections include local plants and many specimens from overseas from other collectors as well as plants he collected there himself. The Rafinesque specimens were through Durand.

Erahan, Dr.: 1. *Paris quadfifolia,* 1826.

Facchini, Dr.: 2. Fiema, 1858. Through Edward Tuckerman, Jr.

Fischer, Prof.: 2. Sent seeds, *Hibiscus trionum* to Miss E. C. Morris, Germantown, PA. Probably of St. Petersburg, Russia.

Franklin, Sir John, 1786–1847: 19. Arctic explorer. Sir John Franklin set out in 1845 looking for the Northwest Passage with two ships and 129 men. They became locked in the ice and all were lost. In the years following his disappearance over 40 parties were sent to find traces of the expedition. These contributed considerably to the world's information on the arctic. The plants in the herbarium are from his 1825–1827 arctic surveying expedition. Specimens housed separately in the herbarium.

Freedly, Dr. Samuel, 1799–1835: 635. Philadelphia botanist, collected extensively in Europe.

Freyer, Heinrich, 1802–1866: 3. Austrian botanist, through Edward Tuckerman, Jr.

Galloway: 1. Probably George Galloway, seed merchant, Helensburgh, Dumbartonshire, England, d. 1879.

Germain, Jacques Nicolas Ernst De Saint-Pierre, 1815–1882: 28. French botanist.

Guillet: 1. Paris, 1837.

Harvey, Dr. William H., 1811–1866: 277. Keeper of the herbarium, University of Dublin. Algae specialist. Algae specimens from the Great Barrier Reef of Australia number 272.

Hampe, George Ernst Lugwig, 1795–1880: 1. German botanist, through Edward Tuckerman, Jr.

Hausmann, Franz Von, 1810–1878: 10. Bryologist, botanist, Austria, through Edward Tuckerman Jr.

Helm: 1. M. Ural, *Cortusa matthioli.*

Hooker, Sir William Jackson, 1785–1865: 1393. Director, Royal Botanic Gardens, Kew. Many of the specimens have reference to his publications. A fine series of *Salix.*

Jacquin, Nicolas Joseph, 1727–1817: 1. Professor of botany and chemistry at the University of Vienna.

La Lune, Dr.: 1. Boulogne.

Martins, Charles-Frederic, 1806–1889: 98. Botanist, France, many specimens from Egypt.

McNab, William, 1780–1848: 1. Superintendent of the Royal Botanic Garden at Edinburgh. Through W. J. Hooker.

Noe, Dr.: 1. "Fiume" Probably Dr. Friedrich Wilhelm Noe, d. 1858.

Nolte, Prof. Ernst Ferdinand, 1791–1852: 1. German botanist, through Edward Tuckerman, Jr.

Rafinesque, Constantine Samuel, 1783–1840: 303. Botanist, scientist, naturalist, professor Transylvania University, Kentucky, Philadelphia. A very controversial botanist of his time. Not liked by Dr. Darlington as indicated by notes on some plants. Considered by some today as a genius of his day. His plants are from all over the world and are housed separately in the herbarium. The Rafinesque specimens came to Darlington through Elias Durand who went through Rafinesque's herbarium after his death in Philadelphia and distributed selected material especially from overseas.

Reichenback, Heinrich Gustav, 1824–1889: 39. German botanist, through Edward Tuckerman, Jr.

Reis, Prof.: 1. Through Edward Tuckerman, Jr.

Relby, S.: Umbelliferae, *Ammi copticum.*

Richardson, Dr.: 1. Probably Dr. John Richardson, naturalist of Sir John Franklin's overland expedition (1819–1822). The specimen of *Saponaria* (*Silene*) *acaulis* came from Richardson to John Torrey to Elias Durand to Dr. Darlington.

Richter: 1. Germany. Through Edward Tuckerman, Jr.

Sevinam, Copeland: 2. *Epilobium hirsutum, Epilobium montanum,* "Chanpotrum."

Sibinia. A.: 1. *Adonis vernalis.*

Skinner, Dr.: 2. Liberia, Africa, two specimens through Dr. Pickering (see COLLECTORS OF EASTERN UNITED STATES).

Smith, Daniel B., 1792–1883: 21. President of Philadelphia College of Pharmacy, Germantown. Specimens by Capt. Drinker, "New Holland" (Australia) through D. B. Smith.

Spei, C. B.: 3. Two specimens through Elias Durand.

Sprengel, Kurt, 1766–1833: 1. Halle, Germany, Physician, botanist.

Stiles, Dr.: 7. Probably Dr. Richard Cresson Stiles, 1830–1873, physician, West Chester, PA. Two local specimens, five from Chile.

Surrey: 2. Two species of English orchids "Reigate Hill."

Tenore: 1. Probably Michele Tenore, 1780–1861, botanist, phytogeographer, Italy.

Thomas, Emmanuel, 1788–1859: 2. "Bransson," through Edward Tuckerman, Jr.

Tammasini, Magistratsrath: 2. Probably Muzio Gluseppe Spirito de Tommasini, 1794–1879, Italian botanist. Through Edward Tuckerman, Jr.

Townsend, David, 1787–1858: 1. Treasurer of the Bank of Chester County, PA. One of the founders of the Chester County Cabinet of Science. Worked closely with Dr. William Darlington. Unidentified specimen "Cult" from seeds brought by the U.S. Exploring Party, Oct. 7, 1844 (Wilkes Expedition). See LOCAL COLLECTORS for his large local collections.

Von Koellenstein, K.: 3. "vernona, Auf Huglen, 1842," through Edward Tuckerman Jr.

Watson, H. C., 1804–1881: 2. Phytogeographer, England. Through Sir William Hooker. One specimen, "Devonshire."

Welwitsch, Dr. Friedrich Martin Josef, 1806–1872: 1. A medical doctor from Austria who made extensive plant collections of Angola for the Portuguese government. Discovered *Welwitschia* one of the most unusual plants in the world.

Wierzbicki, Dr. Peter, 1794–1847: 3. German botanist, specimens, 1841.

Wolle, Jacob, 1788–1863: 1309. Justice of the Peace, Bethlehem, Pennsylvania. Made extensive collections of plants of Jamaica (1226 in herbarium). Little locality information, however. Specimens are housed in a separate collection in the herbarium.

Zanaedili, Dr.: 1. "in mont Carp. principalibus." Through J. B. Brace. See COLLECTORS OF EASTERN UNITED STATES.

Zuccarini, Joseph Gerhard, 1799–1848: 1. A professor at Munich. "*Gnaphalium alpinum,* Bavaria." Through Edward Tuckerman, Jr.

LOCAL COLLECTORS

Baily, Hiram, 1793–1871: 5. Resident of Thornbury and Birmingham townships, Chester Co.

Barnard, Vincent, 1825–1871: 1. Naturalist, botanist, entomologist, artisan, Russelville, Chester Co.

Bartram, John, 1699–1777: 118. Collections made in John Bartram's Garden, Philadelphia between 1818 and 1861 by several collectors, especially John B. Carr. 118 specimens.

Bowen, John S.: 1. Member of Chester County Cabinet of Natural Science, lawyer, member of Nebraska legislature, 1860.

Bradford, Dr. James H., 1802–1859: 1. Physician, West Chester from 1850.

Bridges, Dr. Robert, ?–1882: 88. Physician, lived in West Chester in 1850s. Two hort specimens, West Chester. Mostly "Hort Berolin" specimens.

Burnard, V.: 2. Susquehanna, Wyoming near Wilkes Barre.

Butler, John, Esq.: 3. Pokono Mts. 1849, Niagara Falls, 1837.

Cally, E., 1825–1917: 1. Coatesville.

Campbell, S. J.: 2. "Caracas."

Canby, William Marriott, 1831–1904: 18. Businessman, botanist, Delaware.

Carson, Dr. Joseph, 1808–1876: 2. Professor of materia medica and pharmacy at the University of Pennsylvania.

Carr, John B.: 63. Collected many specimens from Col. Robert Carr's garden near Philadelphia, formerly John Bartram's garden.

Cleaver, Dr. Isaac, 1785–1822: 2. Physician, botanist, Philadelphia and Pennsylvania. One specimen with note, "at Harmony beyond the Ohio, 1813." Probably New Harmony, Indiana.

Coates, B.: 1.

Coates, Josiah: 41. Philadelphia and New Jersey. Collections 1832–1849. He gave 36 specimens to the Chester County Cabinet of Natural Science in 1833 (See CCCS report, 1833).

Coates, Sarah: 2. "A lady of extraordinary Botanical acumen and attainments" *Flora Cestrica*, 1853. She later moved to Ohio, 1850.

Conrad, Solomon White, 1779–1831: 63. Professor of botany, University of Pennsylvania. New Jersey specimens.

Cooper, B.: 3. Collections 1829–1833.

Darlington, Benjamin Smith Barton, 1813–1845. 2. Son of Dr. William Darlington, collected in Rio de Janeiro and coast of Mexico while an officer in U.S. Navy.

Darlington, D.: 2. One specimen Suffolk, VA 1831, one NJ, 1829.

Darlington, Howard: 1. One hort specimen, West Chester, 1860.

Darlington, Judge Isaac, 1781–1839: 1. Lawyer, President Judge of judicial district comprising Chester and Delaware Counties.

Darlington, Catta: 1. One hort specimen, West Chester, 1836. This may be Cattell Darlington, not clear.

Darlington, Sarah, 1824–1882: 1. Daughter of Brinton Darlington, first cousin of Dr. William Darlington. One West Chester collection.

Darlington, Dr. William, 1782–1863: 4217. Botanist, educator, historian, physician, West Chester. His many contacts in Chester County, the United States, and overseas resulted in the choice collection of plants that make up the Darlington herbarium. Most of his personal collections are from Chester County, Pennsylvania.

Dawson, J.: 1. One raspberry collection, 1835.

Davis, Garret: 1. Teacher at Bolinar's School, West Chester.

Durand, Elias, 1794–1873: 1629. Curator of the herbarium of the Academy of Natural Sciences of Philadelphia. Local plants and many specimens from overseas.

Derrick, A. H., 1810–1864: 43. Lived in Washington, DC. In 1827 found *Gerardia auriculata* in SW side of Borough of West Chester. One specimen from District of Columbia.

Dallett, F. M.: 3. "Caracas, 1851." Specimens through John Dallett and F. Fell.

Downing, Jos. M.: 2. Beaver Creek, 1833, 1834.

Dundas, Mr.: 1. Cult pitcher plant, *Nepenthes distillatoria*.

Eavenson, Seth: 4. A farmer in West Goshen township, neighbor of Amos Darlington who died in 1836. All specimens, 1829.

Embree, Hannah, 1788–1867: 2. Teacher in West Chester.

Evans, Barton D.: 1. Local hort collection, West Chester, 1862.

Evans, Miss Elisa: 1. Probably the daughter of Jesse Benner Evans of Chester County. One West Chester specimen.

Evans, John, 1790–1862: 16. Businessman, botanist, Delaware County, Pennsylvania.

Evans, M.: 1. Cult in Hortis *Valeriana officinalis*, 1837.

Everhart, Benjamin M. 1818–1904: 3. Businessman, botanist, with special interest in fungi, West Chester.

Fells, S. A.: 1. Germantown, one specimen, Boot Tavern, 1866.

Fergus, Mrs.: 1. One specimen, cult., West Chester, 1847.

Garrett, Davis: 1. Willistown, 1849.

Gheens, Jon.: 3. Local collections, 1828–1830.

Gilbert, K. W.: 1. One collection, *Nelumbium*, 1847.

Gummere, Samuel, 1789–1866: 2. Botanist, horticulturist, Burlington, N.J.

Hale, William: 1. One specimen, mountains of Pennsylvania.

Hall, George W.: 107. Collected in eastern part of Chester County. He was especially interested in native orchids.

Harlan, Harriett: 1. One specimen, 1851, Jona Paxon's woods.

Harvey, T.: 4. Penn Township, collections from 1851 to 1856.

Hibbard, Walter, 1804–1879: 1. Director of National Bank of Chester County. One specimen, Delaware County, Pennsylvania, 1836.

Hodgson, William: 7. Newspaper business, West Chester. Dated specimen, 1830.

Hoopes, D.: 1. 1833.

Hoppes, Benjamin, 1820–1898: 5. Teacher, Westtown School.

Hoppes, Josiah, 1832–1904: 1. Nurseryman, horticulturist, West Chester.

Hoopes, Joshua, 1788–1874: 197. Teacher, educator, botanist, West Chester.

Ingram, J.: 1. One specimen, *Physalis alkekengi*.

Jacobs, Joseph: 4. Postmaster, local botanist, collected in Uwchland, Pikeland.

Jackson, Halliday, 1817–1887: 48. Educator, teacher, botanist, collections from Florida, Wisconsin, Pennsylvania. Florida specimens appear to have been collected by Dr. Alvan Wentworth Chapman. See COLLECTORS OF SOUTHERN UNITED STATES.

Jackson, John, 1748–1821: 21. Horticulturist. John and son William were friends and neighbors of Humphry Marshall. They developed a highly interesting collection of plants at their home in Londongrove. The following note was on one of their specimens, "from John Jackson's garden raised by him from plants brought from the Missouri by Lewis and Clark." Specimen dated Aug. 27, 1818, *Symphoria* (*Symphoricarpos*) *racemosus*.

Jackson, William, 1789–1864: 42. Horticulturist, Londongrove.

Jarner, J. P.: 1. One specimen, *Crypta minisina*, Elatinaceae, 1848.

James, Thomas Potts, 1803–1882: 5. Professor, Philadelphia College of Pharmacy. Contributed the section on mosses and liverworts for Dr. William Darlington's 1853 edition of *Flora Cestrica*.

Jarvis, Thomas P.: 1. One specimen, New Jersey, 1846.

Jefferies, C.: 1. Possibly Chalkley Jefferies, local builder, West Chester. One specimen, *Liriodendron*.

Jefferies, William W., 1820–1906: 4. Cashier of the National Bank of Chester County, 1857–1883.

Jones, Amelia I.: 4. Four specimens "Banks of Schuylkill, 1855." Letter to Dr. William Darlington at Chester County Historical Society dated 1855 refers to specimens "near our house on banks of Schuylkill."

Jones, I. C.: 2. Specimens, "Banks of Schuylkill," 1830.

Kift, Joseph: 8. Florist, West Chester.

Kilvington, Robert, 1803–1881: 8. Well-known florist of Philadelphia.

Knieskern, Peter D., 1798–1871: 17. Local botanist, eastern New Jersey.

Kreamer, Samuel: 1. Ran a general store at Phoenixville. Specimen, cult near Phoenixville, 1860.

Landreth, David, 1802–1880: 3. Horticulturist, businessman, Philadelphia area.

Kimber, Abigail, 1804–1871: 3. Teacher, Kimberton, Pennsylvania.

Latimer, J. R.: 3. Three collections, cult. 1845, 1847, 1856.

Levis, Lewis: 1. Educator, West Chester.

Lukens, Isaiah: 3. Three Jamaica specimens, 1833.

Marshall, John, 1801–1873: 9. West Chester businessman, President of National Bank of Chester County, member Chester County Cabinet of Natural Science. Specimens cult, West Chester.

Marshall, Humphry, 1722–1801: 55. Specimens collected from his botanical garden from 1819 to 1851 by several collectors.

Marsh, Benj.: 4. Two specimen from Plainfield, NJ, 1842.

Martin, Dr. George, 1826–1886: 1. Physician, botanist, especially fungi. One specimen, Pennsbury township, 1849.

McMinn, John: 61. "formerly of Chester County now of Center County, Pennsylvania" *Flora Cestrica*, 1853. Specimens appear to be from Clinton County, Pennsylvania, 1840–1842.

Mercer, Jesse: 2. Chester County Commissioner, on board of directors of National Bank of Chester County.

Meredith, George: 3. Justice of Peace, Chester County. Owned land in East Whiteland Township. Dated specimen, 1830.

Meredith, Isaac, ?–1874: 1. Collections reported from "Isaac Meredith's meadow" by other collectors in the herbarium. Specimen by Isaac Meredith, *Arundo coarctata*, 1830.

Meredith, J.: 1. One specimen, *Panicum*, 1830.

Michener, Ezra, 1794–1887: 126. Physician, botanist, contributed the section on lichens for Dr. William Darlington's 1853 edition of *Flora Cestrica*. One hundred and six of the specimens in the herbarium are lichens.

Miller, Dr.: 1. *Osmunda cinnamomea*.

Millian, J.: 2. One specimen, West Brandywine, one Perry County, Pennsylvania.

Milner, Nathan: 5. East Nottingham. Five interesting specimens, 1852. See *Flora Cestrica*, pp. 53, 114, 166.

Morris, John M.: 1. One specimen, *Taxus*.

Morris, Elizabeth Carrington, 1795–1865: 299. Student of botany, an acquaintance of Thomas Nuttall, Germantown. Specimens include two localities of *Asplenium pinnatifidum*.

Morris, Paschall: 8. Editor of *Farm Journal*, West Chester. Nursery material in herbarium, 1853, 1854.

Muhlenberg, Gotthilf Heindrich Ernst, 1753–1815: 1. Minister, botanist, Lancaster, Pennsylvania. One of America's outstanding early botanists.

Muller, Dr. Johann Christoph: 27. Doctor, botanist, schoolmaster, musical composer, Rappite Community Old Economy, Pennsylvania. Specimens Economy and Wabash (Wabash River in Indiana where there was a Rappite Community). One specimen dated 1815.

Musser, Miss Emma: 4. Teacher, Lancaster, Pennsylvania. Letter in Chester County Historical Society library concerning specimens dated June 7, 1853.

Nuisbait, Joseph: 1. One specimen, Schuylkill, 5 miles below Pottsgrove, 1836. *Justica pendunculosa*.

Otley: 1. Probably Edwin Otley, 1816–?. County Commissioner, One specimen, *Echinospermum virginianum*.

Parker, Benjamin: 1. One specimen, East Marlborough, near Red Lion, 1849.

Passmore, P.: 1. "Naturalized about P. Passmore's garden," *Lamium purpureum*.

Patton: 1. One specimen, *Panicum microcarpon*, 1833.

Pearce, Miss Harriet: 1. One cult specimen, West Chester.

Peirce, Joshua and Samuel: 34. Brothers. Joshua died in 1851. Farmers, horticulturists, Chester Co. Their property became the nucleus of the now well known Longwood Gardens.

Pennington, E.: 1. Possibly Eliza Pennington, member of East Brandywine Church. One specimen, VA, 1832.

Pennock, Casper Wister, 1799–1867: 4. Physician, Philadelphia.

Porter, Thomas Conrad, 1822–1901: 62. Professor at Marshall College and Lafayette College. One half of specimens are from Georgia. See also COLLECTORS OF SOUTHERN UNITED STATES.

Price, Eliz.: 2. Cult, West Chester.

Price, Rachel, 1763–1847: 1. Quaker minister, ran Westtown School with her husband (1818–1830). One specimen, *Crocus* 1831.

Pugh, Evan, ca. 1828–1864: 5. Chemist, botanist, educator. First President of Penn State University. His collections are few but very select and rare plants for the County.

Rich, Thomas: 3. New Castle County, DE, 1828.

Rinehart, Joseph: 16. Explored area around Pughtown on the Schuylkill River in northern Chester Co.

Richardson, Miss H. W.: 2. One specimen, Montour Co., PA, one New Castle Co., DE (*Viscum flavescens*, 1847). Letter in Chester County Historical Society Library concerning *Viscum flavescens* (mistletoe) dated July 21, 1847.

Riley, Henry A.: 2. Susquehana Co., PA, Montrose, 1851.

Rivinus, Dr. Edward F., 1802–1873: 4. Physician, member of Chester County Cabinet of Natural Science. Lived in West Chester for several years. Died in France.

Schweinitz, Lewis David von, 1780–1834: 435. Minister, botanist, especially fungi. Collections mostly Eastern Pennsylvania. An outstanding early American botanist. See also COLLECTORS OF EASTERN UNITED STATES.

Seal, Thomas F., 1788–1875: 3. Unionville, Chester Co. One specimen dated 1843.

Sharples, Dr. John Townsend, 1801–1883: 13. Physician, Philadelphia. Chester County Cabinet of Natural Science report of 1826, "plants donated by John T. Sharples M.D. of Philadelphia."

Sharples, Nathan, H., 1799–1838: 9. Builder, farmer, West Chester. Member of Chester County Cabinet of Natural Science. Nine local specimens (1828–34).

Sharples, S. Emlen, 1828–1914: 8. Son of Nathan H. Sharples of West Chester. Carpenter, businessman. Specimens all cult, West Chester.

Shields, Edw.: 1. One specimen, "barrens Hugh M' Kennas," 1843.

Shoemaker, Mr. Benj.: 2. Two specimens near West Chester, 1854, 1857.

Smith, Daniel B., 1792–1883: 21. President of Philadelphia College of Pharmacy, Germantown. Specimens from "New Holland by Capt. Drinker through D. B. Smith." Australian specimens. See COLLECTORS OF OVERSEAS.

Smith, Dr. George, 1804–1882: 1. One of founders and President of Delaware County Institute of Science for 49 years (Pennsylvania). One specimen, Delaware Co., PA, *Quercus macrocarpa*, 1848.

Steele, John D., ?–1866: 10. A native of England, farmer, West Bradford Township.

Steele, Miss: 1. Hort specimen, 1829.

Steinhaur, Daniel, 1785–1852: 34. Born in Wales, teacher in Moravian schools in Pennsylvania, Ohio, and Louisiana. See also COLLECTORS OF SOUTHERN UNITED STATES.

Stiles, Dr. Richard Cresson, 1830–1873: 2. Two West Chester specimens.

Stringfellow, S.: 2. Two specimens, 1828, 1829.

Swan, E. D., Jr.: 1. *Caltha palustris*, "Cold Spring," 1827.

Tatnall, Edward, 1818–1898: 48. Botanist, Wilmington, Delaware.

Taylor, Annie: 2. Two specimens of mistletoe, "Germany, Christmas, 1856. *Viscum album*."

Thomas, J. R.: 3. two specimens are of local orchids, 1829, 1831.

Thomas, Dr.: 3. Probably Dr. George Thomas (1808–1887). Physician, more interested in horticulture than medicine. Two cult specimens, West Chester, 1852, 1869.

Thomson, Dr. J. W.: 1. Talbot County, Maryland, 1849.

Townsend, Albert: 2. Son of David Townsend of West Chester. Two local Chester County specimens. 1837, 1838.

Townsend, David, 1787–1858: 2379. Treasurer of the Bank of Chester County. One of the founders of the Chester County Cabinet of Natural Science. Made extensive collections of Chester County plants working closely with Dr. William Darlington. One unidentified specimen with the following label, "Cult from seeds brought by the U.S. Exploring Party. Oct. 7. 1884." This was the Wilkes Expedition.

Townsend, Elwood: 1. One specimen, local orchid, 1852.

Townsend, Eusebius: 1. Lived in West Chester. Specimen Cape May, NJ.

Townsend, John W.: 4. On board of directors of the National Bank of Chester County. One dated specimen, 1852.

Townsend, Washington, 1813–1894: 7. Cashier of the Bank of Chester County (1849–1857). Son of David Townsend. Specimens from Chester Co., 1828–1836.

Trimble, James: 13. Cecil County, Maryland. Six specimens dated 1830.

Twiddle, Mrs.: 1. Cult specimen, West Chester, 1840.

Valentine, Jon.: 2. Great Valley, 1839.

Walters, W.: 1. One specimen near Brandywine, 1831.

Walton, Joseph, 1823–?: 1. Botany teacher, Westtown School, 1836–1846.

Weitzel, Tabitha: 2. Sunbury, PA. Label on specimen, "Hills opposite Sunbury, 1850." Letter from Dr. William Darlington to Miss Tabitha Weitzel, Sunbury, PA, dated March 27, 1850 at Chester County Historical Society library.

Whitaker, P.: 1. One specimen, cult, West Chester, 1858.

Williams, S.: 1. One specimen, Pine Creek, 1841.

Wister, William Wynne, 1807–1898: 9. Businessman, banker, amateur botanist. Son of Charles J. Wister. Local and regional collections. One dated 1862.

Wister, Charles J., 1772–1865: 3. Member of American Philosophical Society. Friend of Thomas Nuttall. Three specimens, cult, Germantown.

Worthington, Dr. Wilmer, 1804–1873: 29. Physician, educator, student of Dr. William Darlington. Member of Chester County Cabinet of Natural Science. Local specimens 1825–1832.

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Bartonia No. 57: 95–97, 1992

The First Pennsylvania Record of Bog Aster (*Aster nemoralis* Aiton, Asteraceae) and Other New County and Site Records for the Algerine Swamp Natural Area

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402 Laurens St., Olean, NY 14760

On 25 August, 1988, a population of *Aster nemoralis* Ait. was discovered in the Algerine Swamp Natural Area, located on the Lycoming-Tioga County boundary line, Pennsylvania. The Algerine Swamp is known more commonly locally, and historically, as the Cedar Run Bog (Swamp) (de fide Blair Carbaugh and Kenneth Settlemeyer, Lockhaven University, Lockhaven, Pennsylvania).

About a dozen (+) flowering stems were distributed over an open *Sphagnum* area of approximately 100 square meters. A voucher specimen has been deposited in the herbarium of the Academy of Natural Sciences of Philadelphia (PH) (Edith and J. Rudolph Schrot, 25 Aug 1988). Other voucher specimens collected from the site are indicated below with collectors' names, collection date, and acronym for the herbarium where they have been deposited.

The *Aster* collected fits the species description in Fernald (1950), and scores as a definite *Aster nemoralis* on the hybrid index of Pike (1970), which distinguishes *Aster nemoralis, A.* × *blakei, and A. acuminatus* on the basis of leaf and inflorescence characteristics. Its occurrence has not been previously reported for the State of Pennsylvania (Jennings and Avinoff 1953; Wherry et al. 1979; Brouillet and Simon 1981; Thompson et al. 1989; pers. comm.: John Kunsman, Pennsylvania Natural Heritage program; Kathy McKenna, Pennsylvania Department of Environmental Resources; Alfred E. Schuyler, Academy of Natural Sciences of Philadelphia; Sue A. Thompson, Carnegie Museum of Natural History, Pittsburgh; Paul Wiegman, Western Pennsylvania Conservancy, Pittsburgh).

Algerine Swamp is a wooded 100–120 acre boreal bog (Pennsylvania Natural Diversity Inventory, 6 May 1991), at an elevation of 1810 ft, 3.3 km NW of Cedar Run, at the headwaters of Red Run. It is located in an area of pre-Wisconsin Muncy drift and colluvium, between the glacial border deposits of late Wisconsin age and those of Altonian and Illinoian age (Crowl and Sevon 1980).

Dominant on roughly ¾ of the site are *Abies balsamea, Picea mariana, Tsuga canadensis,* and *Pinus stobus. Pinus rigida* P. Mill, previously unreported for Tioga County (Thompson et. al. 1989; Wherry et. al. 1979), is also a significant element of the swamp forest community (Edith Schrot and J. Rudolph Schrot, 27 Apr 1991, PH). It has been collected in the Lycoming County section of the swamp (K. Settlemeyer, 13 Aug 1970, Lockhaven University, Coll.# 887). *Pinus rigida,* typically an inhabitant of dry, sandy or barren sites (Gleason and Cronquist 1963; Fernald 1950), also commonly inhabits northern lowland bogs and conifer forests (Larsen 1982), and therefore could be expected as a native element in the more southern boreal relic communities such as the Algerine Swamp. A few scattered individuals of *Amelanchier* × *intermedia* Spach (Edith and J. Rudolph Schrot, 27 Apr 1991, PH) previously unreported for Tioga and

Lycoming Counties, are present. Shrubs include *Chamaedaphne calyculata, Vaccinium* sp., *Rododendron maximum,* and *Ilex verticillata. Gaultheria hispidula,* found throughout, thickly carpets the hummocky areas, along with *Coptis trifolia* ssp. *groenlandica* and *Cornus canadensis.* Scattered open areas support *Vaccinium oxycoccos, V. macrocarpon, Sarracenia purpurea, Drosera rotundifolia, Carex folliculata, C. gynandra, C. paupercula,* and *Scirpus cyperinus.*

Carex rostrata Stokes var. *utriculata* (Boott) Bailey and *Eriophorum virginicum* L. are in openings, and *Lycopodium innundatum* L. is in an open area in a spring run (all three species collected by Edith and J. Rudolph Schrot, 27 Apr 1991, PH). They were all previously unreported for the Algerine Swamp (Thompson et al. 1989; Wherry et al. 1979). A small stand of *Menyanthes trifoliata,* also previously unreported, was observed at the edge of one of the open areas west of the *Aster nemoralis* stand (Edith and J. Rudolph Schrot obs., 25 Aug 1988).

Eriophorum vaginatum L. ssp. *spissum* (Fern.) Hulten, new to Tioga County (Thompson et al. 1989; Wherry et al. 1979), was found at the western end of the site in a wooded hummocky area, growing in the immediate vicinity of *Pinus strobus, Abies balsamea, Gaultheria hispidula, Chamaedaphne calyculata, Vaccinium* sp., *Saracenia purpurea,* and *Ilex verticillata* (Edith and J. Rudolph Schrot, 27 Apr 1991, PH).

Aster nemoralis Ait. characteristically inhabits cool, acidic bogs. Distribution records have been limited to areas of Wisconsin glaciation, with the exception of the southern border of its range along the coastal plain in New Jersey (Brouillet and Simon 1981). The northern limit of range corresponds approximately with the range of the boreal forest (Brouillet and Simon 1981). The new site reported here represents a western expansion of the known southern range.

Brouillet and Simon (1981) have postulated a probable coastal plain–continental shelf refugium for *Aster nemoralis* during the period of Pleistocene glaciation, with migration northward through New Jersey and Long Island as the ice front retreated.

The presence of *Aster nemoralis* in north central Pennsylvania, and a record in Niagara County in northwestern New York State (New York Flora Association 1990), not included on Brouillet and Simon's (1981) distribution map, could be further evidence for a westward migration from a refugium on the coastal plain, as they have postulated for northern populations. It could also indicate the possibility of additional refugia in the unglaciated Allegheny Mountains and Plateau, with the Algerine Swamp site representing a relic population.

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OBITUARY

William Lewis Freyburger (1907–1990). On September 7, 1990 William L. Freyburger died from heart failure at the Humana Hospital, St. Petersburg Florida. Bill, as he was known to his friends, was born on August 5, 1907, in Philadelphia, Pennsylvania. After Bill graduated from high school in Philadelphia, the Freyburger family moved to the Penfield section of Haverford Township, Delaware County, Pennsylvania. A short time after his retirement from John B. Kelly Inc. of Pennsylvania, he and his wife, Helen, moved to St Petersburg, Florida, in December 1971. From childhood, Bill was interested in moths and butterflies. After many trips with the Boy Scouts he became interested in wildflowers, trees, ferns, and birds.

During World War II, Bill served as a Supply Sergeant in the United States Army Air Force. Later in life, "boy meets girl," who also liked to hike and was interested in botany. Sometimes on their walks they would cover a mile in thirty minutes or less, sometimes it would take thirty minutes to go the distance of a city block depending on the variety of plants. Before long they were specializing in "just wildflowers," keeping a log of flowering dates and plants. Trips covered all the neighboring counties of Philadelphia. For a Christmas present, Helen gave Bill a membership to the Academy of Natural Sciences. Eventually friendship ripened into love and on May 25, 1957, Helen Rauch became Mrs. William Freyburger. On a field trip to New Jersey with the Academy, they met Edgar T. Wherry and Ida Langman who told them about the Philadelphia Botanical Club. Ida Langman sponsored their membership to the club.

Bill had many interests and hobbies. He belonged to three contract Bridge Clubs and earned quite a few master points. He also belonged to the Haverford Township Historical Society which he helped reactivate after it was in limbo for a number of years. Book collecting was another hobby and after a visit to Florida, Edgar T. Wherry remarked that Bill had more natural history books and a better collection than the Public Library.

William L. Freyburger served as treasurer of the Philadelphia Botanical Club for 12 years, resigning in October 1971. HELEN FREYBURGER.

Bartonia No. 57: 99–103, 1992

REVIEWS

100 Families of Flowering Plants, 2nd ed., by Michael Hickey and Clive King. Cambridge University Press, Cambridge. 1988. 619 pp. $82.50 (cloth).

This book is a textbook on systematics of flowering plants aimed at beginning botany students, thus the 100 families chosen out of 300–400 are intended to give the student a comprehensive view of the angiosperms without being overwhelming. The order of the families follows Davis and Cullen's *The Identification of Flowering Plant Families*, which is an updated version of G. L. Stebbin's *Flowering Plants Evolution above the Species Level* (1974).

Each family description consists of three parts: (1) treatment of the family as a whole, its world distribution, general characteristics, principal economic and ornamental plants, and mention of its more important genera; (2) a detailed description of a plant (sometimes two) chosen to represent the family, distribution, vegetative and floral characteristics, and pollination, including mention of substitute plants to study; and (3) pen and ink drawings of the chosen plant(s) showing clearly its floral characters and often its growth habit. Each drawing is accompanied by an explanation and a size conversion scale.

As a reference for student and professional alike, the book is very good in a number of aspects. It contains a clear and illustrated introduction to the different growth forms, aestivation, floral structures, anther forms, placentation, and fruit types, with significant terms printed in bold type. As in any good textbook, features such as basic abbreviations and a geological time scale (although not very detailed) are also included.

The wide-page format, hard cover, and drawings of many different floral organs which were drawn from live specimens make the text highly useful for instant referencing in the laboratory while examining live material. Furthermore, the glossary at the end is substantive and handy—I find the absence of glossaries in reference books disappointing. At the end of the text, four tables are included, grouping the families into a number of different associations. These tables can be helpful, but do not seem to be important or worthy of regular use.

Although the book is a good beginning text for laboratory work in systematics, it fails to mention, much less describe, other aspects of botany such as collection and mounting techniques, nomenclatural procedures, and historical botany—supplemental information which is very useful for giving the beginning student confidence that she/he has touched upon all bases and has a solid footing in botany. In contrast, *Plant Systematics*, a text by Jones and Luchsinger, is weak on family descriptions, but covers many more aspects of botany—information which I found valuable. In addition, although the narrowing of focus to fewer families than actually exist was necessary, I find that a complete listing of all the families—absent in this book—is extremely important if only in an appendix, for giving the student the full scope of the angiosperms and to place the book's contents in context. The lack of this not only forces the interested beginner to reference supplemental literature (Cronquist's *An Integrated System of Classification of Flowering Plants* (1981), for example), but also diminishes its value as a reference for professional botanists.

Most disappointing in this text is the lack of information on the classification system used and on classification systems in general—integral bases of the field covered. Little explanation was given as to why those particular families were chosen and what their relationships are to each other, likely to leave gaping holes in the student's understanding of systematic botany. Any instructor would have to supplement this book with such information, either through lectures or through other literature.

For students of botany, this text serves very well as a laboratory aid and its mention of layperson information such as ornamental values of the families helps attract the student's interest; however, fundamental aspects of systematic botany are lacking, rendering it of limited value as a general textbook of this subject. CAMILLE BARR

Modern Methods in Orchid Conservation: The Role of Physiology, Ecology and Management, edited by H. W. Pritchard. Cambridge University Press, Cambridge. 1989. x + 173 pp. $47.50 (cloth).

This book is based upon the proceedings of a national symposium held in 1986 at the Royal Botanic Gardens, Kew, England. It contains 15 articles, varying in length from 4 to 18 pages, on orchid conservation from three perspectives: physiology, ecology, and management. This well-bound book has an attractive front cover with a colored-drawing of *Maxillaria acicularis*. The tables, figures, and black and white plates are of high quality, and except for a few typos the book reads well. The index, however, does not contain an alphabetical listing of the species discussed in the articles.

The first 7 chapters cover the physiological perspective. Subjects include pollen germination and storage, effect of temperature and moisture on seed viability, asymbiotic germination, effects of atmospheric composition on seedling growth, and tissue culture techniques. Two other chapters in this section deal with the role of mycorrhizal fungi in the germination and establishment of orchids.

The next 4 chapters cover the ecological perspective: population biology, predicting flowering trends from size and number of leaves, and modeling to predict population trends in two species of *Ophrys*. The last chapter in this section covers the biogeography of British orchids in their European context.

The management perspective is covered in the last 4 chapters. Topics include the role of The Nature Conservancy Council (e.g. orchid wardening and orchid gardens) and the living orchid collection at Kew in orchid conservation, and an interesting chapter describing a self-supporting reserve in the coastal rainforest of Brazil. The last chapter covers importation and exportation laws for orchids.

This book covers a diversity of topics that range from laboratory experiments and field studies to direct conservation practices (e.g. orchid wardening). Unfortunately, missing from the book is an introduction and/or summary to describe the relevance of each topic to the overall goal of conservation and the application of the topic to other families. In this respect, the book attains the editor's goal as being a "useful starting point," but is mostly limited to those involved in orchid conservation. Further, it would have aided the reader if each article gave background information on the orchid species studied (i.e. its distribution, rarity, etc.).

In summary, I feel that the reader is left with a sense of what one country, i.e. England, can do to preserve plants. Further, one better appreciates the need to fully understand the biology of the species in preservation efforts. JEFFREY L. WALCK

Mathematical Ecology of Plant Species Competition: A Class of Deterministic Models for Binary Mixtures of Plant Genotypes, by Anthony G. Pakes and Ross A. Maller. Cambridge University Press, Cambridge. 1990. 193 pp. $49.50 (cloth).

This book is in the series, "Cambridge Studies in Mathematical Biology," which series is aimed at graduate students in mathematical biology. In terms of mathematics it presupposes more than freshman calculus, but little which would not be handled well by any survivor of a course in differential equations. There is a very useful (and nearly complete) index of notation (Table A.1), and the notation is mostly straightforward, although some expressions have the appearance of conditional probabilities until one examines them. Since the book's authors are mathematicians, their presentation is largely in the sequence theorem, proof, discussion. There are places in which many pages go by with no apparent biological relevance, but eventually nearly everything is given or denied a biological setting.

This is a review and extension of models involving seed dormancy for annual plants, as applied to competing strains of *Trifolium subterraneum* L., which is native pasture forage in the Mediterranean area, as well as introduced in North America and Australia. Most of the book is concerned with models of the competition between pairs of strains with possible interference competition from adventitious grasses. The work on seed dormancy is placed within the modern context of evolutionarily stable strategies. The modeling of competition is done as an extension of de Wit's formulations. The analyses are concerned not only with the outcome of competition, but also with the time frame within which the outcome will become apparent.

There is a "reality check," as it were, in that the results are compared with experimental results summarized in the paper by Rossiter, Maller, and Pakes (1985), which the reader is repeatedly advised to consult for information about subterranean clover. The comparisons do suggest that the modelling effort is worthwhile, at least for this setting, while the matter of statistical uncertainty in the estimation of model parameters is handled by varying the parameter estimates and evaluating the outcome again. Lastly, the closing chapter examines the complications introduced by tillage models even for single strains and leaves the reader with the expectation that there is a future in deterministic models of plant population dynamics evaluated mathematically.

If you wish to consider a case study approach to presenting the "nuts and bolts" that must go into modeling population dynamics, this book has many of the features you might want to present. On the other hand, it is not a "how to" book; I doubt any are.

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JOHN A. HENDRICKSON, JR.

Plant Canopies: Their Growth, Form, and Function, by G. Russell, B. Marshall, and P. G. Jarvis. Cambridge University Press, Cambridge. 1989. 178 pp. $19.95 (paper).

One can imagine a Gary Larson cartoon in which photosynthetic algae just out of the sea are covering rocks in an austere Devonian landscape. One alga says to his wife "You know, this terrestrial habitat used to be a nice neighborhood before all the riffraff moved in." Indeed, the early terrestrial habitat was a radical change from the shallow seas in which the autotrophs evolved. In addition to the obvious differences in atmosphere, radiation, and substrate, dry land was relentlessly two-dimensional. Flatness of the substrate soon led to competition for space, as progressively more proto-plants colonized. One evolutionary solution has been vertical growth—a plant precludes resources simply by being higher than its neighbors.

This trend has led to the nearly ubiquitous stem-and-leaves vertical architecture which we see in land plants today. An important consequence of vertical growth is that a plant becomes a heterogeneous three dimensional construction (a canopy), in which some parts control the environment experienced by other parts. For example, leaves in a tree crown cast shade on the leaves below. Physical gradients are strongest when canopies of several plants overlap, and species high in the canopy may rigidly define the environment of shorter species below them. Understanding the character of the canopy environment provides invaluable insights into the evolution of plant form and function. But these questions are of more than academic interest: a crop may be viewed as a human-constructed artificial canopy in which productivity depends on the density and arrangement of the foliage.

The present volume, ''Plant canopies: their growth, form and function,'' is a collection of essays attempting to pull together diverse aspects of canopy structure and microclimate. Early chapters (Campbell and Norman; Russell, Jarvis and Montieth) provide concise discussions of canopy macrostructure and radiation balance. A particularly lucid chapter (M. Raupach) deals with scales of atmospheric turbulence within and above the canopy, offering a much-needed bridge between leaf-level microclimate and landscape-level meteorology.

Taking the viewpoint of the individual plant, J. L. Harper describes with typical clarity and simplicity the patterns of leaf production by which canopies are produced and maintained. Longevity and arrangement of individual leaves has a great impact on a plant's performance, and observed patterns of leaf demography suggest both architectural adaptation and developmental limitations on evolution. Other organism-oriented chapters deal with branching patterns (Porter) and the radiation balance consequences of leaf angle (Ehlringer and Forseth).

However, this level of quality is not maintained throughout. One seemingly irrelevant chapter is devoted to mathematical models of large-scale convection well above the earth's surface. The final chapter, nominally a synthesis, is little more than a superficial discussion of the pitfalls of computer modelling. Several authors rely heavily on older work, with few recent references.

The most serious complaint involves the structure of the volume as a whole. As plant canopies are treated here, the topic may include any above-ground feature or function of a plant or group of plants. Given this leeway, chapters do not complement one another, and, as often the case in collections of essays, there is little thematic continuity between authors. The editors have failed to clearly define the central theme, and the reader is hard-pressed to draw the connections himself. The most egregious gap falls between the obscure physical/mathematical systems approach based on crop ecosystems, and the evolutionary/organismal approach implicit in discussions of plant demography and physiology. Perhaps the writing of such a book should be left to a single author with a single coherent vision. Fenner (1985) and Vogel (1984) come to mind as particularly successful recent examples. The physical complexity and ecological importance of plant canopies, and the fragmentation of the literature which deals with them, certainly warrant a book-length synthesis but this volume doesn't fill the need. I recommend that readers photocopy a chapter or two, and leave the rest in the library.

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GLENN MATLACK

Ewaniana: The Writings of Joe and Nesta Ewan, compiled by Keith Crotz with a preface by Ian MacPhail and introduction by Emanuel D. Rudolph. The American Botanist, Booksellers, Chillocothe. 1989. 64 pp. $25.00 (cloth).

In a talk at the Morton Arboretum in 1976, Ian MacPhail dubbed Joe Ewan as *homo americanus philadelphicus*. This designation is apt because of Joe's birth in Philadelphia and his interest in the history of Philadelphia botany. He has a natural affinity for libraries and archives, and the capacity to distill knowledge from these sources for the benefit of those who have an interest in botany and natural history. Witness his contribution in the early pages of this issue of Bartonia.

Joe often stands before us and glitters with his intellectual showmanship. Less conspicuous, but no less important, is Nesta who retains an element of her Canadian birth with her married surname—the last four letters of Saskatchewan.

The bibliography of the Ewan's work compiled by Keith Crotz is remarkable and all the more useful because it includes references to virtually all of their printed words. Book reviews and grant reports are included along with publications on botanical history and systematic botany. In all, 358 citations are listed, and already the list is out of date—the space allotted on page 45 for additions might be sufficient for those who can write microscopically.

The members of the Philadelphia Botanical Club are indebted to the Ewans for their willingness to delve into the lives of botanists associated with Philadelphia and the botanical club. For the botanical community in general, Emanuel Rudolph points out in his introduction that "This bibliography is full of 'plums' waiting to be plucked out. The detailed index will lead the user to the many persons and topics hidden behind the titles. A Ewan book review usually has leads and references that await those interested. It is indeed a great service to scholarship to have a printed version of the bibliography of Ewan's writings so that all may profit from their wisdom." ALFRED E. SCHUYLER

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NEWS AND NOTES

CHORISPORA TENELLA (PALL.) DC. (BRASSICACEAE) IN PENNSYLVANIA. The discovery of an unfamiliar mustard in Conestoga Township, Lancaster County, in May, 1989, by Miller proved to be noteworthy. Determined by Parks to be *Chorispora tenella* (Pall.) DC., the taxon was not found listed in the Atlas of the Flora of Pennsylvania (Wherry, Fogg, and Wahl 1979). Sue Thompson of the Carnegie Museum (pers. comm.) found no records at CM. However, consultation with Kasia Fogarasi and Ann Rhoads at the Morris Arboretum (pers. corr.) yielded two recent records from the Flora of Pennsylvania Data Base. The earlier is a collection by P. Noon (determined by R. Jensen) obtained May 4, 1981, near Albright College Apartments in Reading, Berks Co., and deposited at Albright College. Susan Munch, currently of Albright College, concurs with the determination. The second was collected April 6, 1988, in Pequea Township, Lancaster Co., along the edge of a cultivated field, by Rick Mellon and is on deposit at MOAR. Our record is Parks 5052, collected May 15, 1990, in Conestoga Township, Lancaster Co., near the intersection of River Road and Sickman Mill Road. Specimens are deposited at MVSC, CM, and PH.

We publish this information to alert botanists about the presence of this mustard in Pennsylvania. The plants were very abundant at our location which was a disturbed construction site. A plant nursery across the road, where the taxon also grew in abundance, may be the source of introduction. *Chorispora tenella* may prove to be a noxious weed in Pennsylvania so its presence should be monitored carefully.

Gleason and Cronquist (1963) report *Chorispora tenella* as native to central Asia, established in the dry areas of the Pacific northwestern U.S., and occasionally adventive in our area. The only state contiguous to Pennsylvania reporting *Chorispora tenella* is Ohio (Weishaupt 1971; Cusick and Silberhorn 1977). John Furlow of The Ohio State University reports only two collections present in the herbarium, both from Pickaway Co. in central Ohio. They were collected in 1961 and 1971 by Floyd Bartley from a pasture and railroad yard respectively. The more recent eastern stations reported here are almost 500 miles across the Appalachian Mountains with no intervening sites known. Clearly, *Chorispora tenella* presents intriguing questions of dispersal and establishment to Pennsylvania botanists and reminds us of the dynamic nature of our flora.

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JAMES C. PARKS AND KENNETH G. MILLER

TWO NEW ADVENTIVES FOR NEW JERSEY. *Acalypha australis* L., a member of the Euphorbiaciaeae, was recently found in New York City (See Bull. Torrey Bot. Club 117, No. 3). Not unexpectedly, it has now appeared in New Jersey. On September 23, 1991, I found six plants of this Asiatic species growing at the edge of a parking lot in Little Ferry, Bergen County. The plants were taller than nearby specimens of *Acalypha* *rhomboidea* and had a more lanceolate leaf shape. The best distinguishing feature of *A. australis* is that the bracts subtending the pistillate flowers are cordate and essentially entire, unlike the five- to seven-lobed bracts of our other members of this genus.

Polygonum perfoliatum L., the "mile-a-minute vine" that has been known from the Philadelphia area since about 1946, has also crossed into New Jersey. On September 8, 1991, several fruiting specimens of this spiny vine were discovered in disturbed soil in Oldman's Township, Salem County, by Mr. John Courtney, who brought me specimens. For those who do not know it, this Asiatic member of the Polygonaceae has spiny stems much like *Polygnum arifolium,* deltoid leaves, and ocreae that are expanded into leafy perfoliate blades. It has blue, berry-like fruit. KARL ANDERSON

1990 DELAWARE RARE PLANTS SURVEY HIGHLIGHTS FOR NORTHERN NEW CASTLE COUNTY. In 1990, the Piedmont and Northern New Castle County team of botanists (Ann Newbold, Janet Ebert, Jack Holt, A. E. Schuyler, with assistance from Sally Andersen) working under the funding of the Delaware Natural Heritage Inventory program, continued to explore the state for rare and endangered species of plants, with more emphasis on the coastal plain of central New Castle County. However, searches in the Piedmont and its drainage basins continued, as we had not nearly exhausted all possibilities of new discoveries there.

In the Brandywine Valley we found a second station for the fern *Pellaea atropurpurea* on a roadside rock wall, the grass *Sphenopholis pensylvanica* in a shaded woodland seep, and *Helianthus divaricatus* on a railroad bank. Most exciting, though a secondhand discovery, was learning from Donald Huttleston of the Philadelphia Fern and Wildflower Society of his and John Scott's discovery of a new state record, the fern *Cystopteris bulbifera,* at our original *Pellaea atropurpurea* site—our previous visits there had been too early for the fronds to achieve full size and grow their distinctive bulblets.

The White Clay Creek drainage, due to previous surveys and restrictions on where we could explore, produced few rarities in 1990. However, on one estate where we received permission to visit, we found nearly a dozen state rarities, including *Dryopteris clintoniana, Monotropa hypopithys, Oxalis violacea,* and *Liparis lilifolia.*

The Red Clay Creek, as in previous year, produced more than its share of rarities. Newly rediscovered species included *Carex granularis* and *Aureolaria pedicularia;* second statewide plant sightings included *Equisetum sylvaticum, Zizia aptera, Dryopteris goldiana,* and *Amianthium muscaetoxicum.* Other notable finds were *Asclepias exaltata* and *Panax quinquefolius* (found on a Philadelphia Botanical Club walk), *Viola rotundifolia,* and *Triosteum aurantiacum.* The most exciting finds were the new state records *Scirpus pendulus,* and yet another fern, *Diplazium pycnocarpon* (*Athyrium pycnocarpon*), on one of the last days of surveying.

On the Fall Line of New Castle County and south to the Chesapeake and Delaware Canal, we had much success. In the Christina River drainage, discoveries included *Melanthium virginicum, Aletris farinosa, Lysimachia hybrida,* and numerous stations for *Lycopodium clavatum,* revealing that that clubmoss was not nearly as rare as had been previously recorded. Exploring along the shores of the Delaware River, we revisited sites for *Bidens bidentoides,* and located stations for *Sagittaria graminea,* the new state record *Typha domingensis,* and *Najas gracillima,* the last at perhaps its only remaining Delaware River station. Other notable rediscoveries in the various drainages of the northern Coastal Plain included *Hypericum gymnanthum, Stachys hyssopifolia,* *Glyceria acutiflora,* and *Smilax pseudo-china;* still other species of plants found included a large population of *Isoetes engelmannii, Rotala ramosior, Cuphea viscosissima,* and *Scirpus purshianus.* Finally, continued exploration of the Iron Hill area rewarded us with stations for *Eupatorium coelestinum, Corallorhiza odontorhiza,* and lastly, in a roadcut, *Lobelia spicata, Sisyrinchium mucronatum,* and *Scleria pauciflora,* species more normally associated with serpentine barrens. JACK HOLT, JANET EBERT, ALFRED E. SCHUYLER

CHIONANTHUS VIRGINICUS—FRINGE-TREE FOUND IN NEW YORK. The fringe-tree is known from as far north as southern New Jersey in most local floras. However, during a wetland delineation project near Orangetown, Rockland County, New York, a specimen was collected in a stream-side woodland on June 19, 1989. Subsequently, this specimen was sent to the New York State Museum and confirmed by Dr. Charles Sheviak. It must still be determined if this specimen represents a naturally occurring population or having been seeded-in from cultivated sources. BILL OLSON

POTAMOGETON OBTUSIFOLIUS IN SOUTHCENTRAL ALASKA. A specimen of *Potamogeton obtusifolius* was collected by me in Palmer, Alaska on July 22, 1991 in a small, unnamed pond (T18N R2E S13) at a depth of 0.25 m. The specimen is housed at the University of Alaska Fairbanks museum herbarium (ALA, Accession #V108840). *P. obtusifolius* is not listed in Hulten's *Flora of Alaska and Neighboring Territories.* While only one clump of plants was noted at the first collection site, *P. obtusifolius* was also observed to be common at nearby, shallow Mud Lake (T17N R3E S17), where it grew with *P. gramineus* and *P. richardsonii.* The Mud Lake specimens have been deposited in the herbarium of the Academy of Natural Sciences of Philadelphia. These observations point to the need for further examination of the aquatic flora in Alaska. Thanks to Ernie Schuyler for identification and Carolyn Parker at the University of Alaska museum for assistance in looking through *Potamogeton* specimens in the herbarium. LYNN FULLER

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1990 FIELD TRIPS

May 6: Tyler Arboretum, Lima, Delaware Co., PA. We visited the serpentine barrens where *Phlox subulata* was in full bloom along with many other plants. We also visited the Dismal Run trail. In bloom were *Galearis spectabilis, Silene caroliniana* var. *pensylvanica, Uvularia perfoliata, Trillium cernuum, Mitella diphylla,* and *Tiarella cordifolia*. This area is extremely rich in plant life. Leader: John Ballas.

May 12: Mt. Cuba, New Castle Co., DE. We started the trip with an easy walk along the railroad tracks next to Red Clay Creek, where we saw such Delaware rarities as *Pedicularis canadensis, Ranunculus hispidus, Orobanche uniflora, Dirca palustris,* and *Asclepias exaltata*. The going got rougher when we turned into the Red Clay ravine, but we were rewarded with the sight of *Mitella diphylla, Galearis spectabalis, Trillium cernuum, Hybanthus concolor,* and *Dryopteris goldiana*. John Ballas succeeded in discovering a population of *Panax quinquefolius*.

A side trip east of the Red Clay took us to a population of *Amianthium muscaetoxicum*.

After lunch, a smaller party explored a rich woods north of Hoopes Reservoir, where we found a large group of *Obolaria virginica*. Leaders: Janet Ebert, Jack Holt.

May 19: Forked River, Ocean Co., NJ. Our aim was to explore the coastal wetlands, pine barrens, and cedar swamps that straddle Route 9 between the State Game Farm and the Oyster Creek. Producing nearly 500 species of vascular plants, this region was a popular Torrey Botanical Club site during some 10 field trips from 1935–1970. A station of *Listera australis,* first reported in 1947 by the late Tilly Weingartner, was rediscovered. An extensive search turned up five spots totalling about 150 plants in anthesis. Other noteworthy species seen were *Viola brittoniana* (incl. var. *pectinata*), *Salvia lyrata, Platanthera clavellata, Aletris farinosa, Carex lanuginosa,* and at the edge of a brackish marsh, *Crataegus crus-galli, Pycnanthemum setosum, Carex hormathodes,* and *Hierochloe odorata*. Our search for *Arethusa* and *Schizaea* along the banks of the Middle Branch of the Forked River west of Route 9 (Ostrom) was unsuccessful; however, we did find *Carex livida* and *Narthecium americanum*. A rare naturalized crucifer, *Teesdalia nudicaulis,* occupied dry, disturbed ground. On a scouting trip of the previous day, *Carex barrattii* was located on the edge of an abandoned cranberry bog near the South Branch east of Route 9. Considerable choice habitat between the Oyster Creek and the Middle Branch has been destroyed since the late 1960s by the erection of a nuclear power plant and more recent construction. Leader: Ted Gordon.

June 3: along Perkiomen Creek at Spring Mount, Montgomery Co., PA: Starting at the Lower Ski Lift Entrance, we walked an abandoned township-owned woods road which parallels the creek. There, along almost two miles of dirt road, we named 208 species. Thirteen of them were ferns which included *Gymnocarpium dryopteris* and *Adiantum rhizophyllus*. Twenty-three of them were carices including *Carex trichocarpa* and *C. davisii*. Among the other interesting and more unusual herbaceous plants were *Poa nemoralis, Liparis lilifolia* in fine photographic form, *Porteranthus trifoliatus, Hypoxis hirsuta, Thaspium barbinode* and *T. trifoliata f. rubra, Orobanche uniflora, Trillium erectum, T. cernuum, Conophilis americana, Silene stellata, Penstemon hir-*

sutus, and several luxurious plants of *Adlumia fungosa* in full bloom. However, *Clematis verticillata,* known to live on the upper slopes, eluded the eagle eyes of Jack Holt and Carl Williams who thrashed diligently through the thick undergrowth and the huge boulders in search of it. Leaders: Ann Newbold and Heinrich Zoller.

17 June: Atsion, Burlington Co., NJ. We visited several interesting wildflower sites in Wharton State Forest. In bloom were *Calopogon tuberosus, Polygala lutea,* and *Scutellaria integrifolia.* We had lunch in the lake region where we saw some *Drosera intermedia* and *filiformis* in bloom along with *Rhexia virginica* and many other plants. Leader: John Ballas.

June 17–21: Snowshoe, WV. The 1990 Joint Field Meeting of the Philadelphia Botanical Club, the Northeastern Section of the Botanical Society of America, and the Torrey Botanical Club was housed at the Whistlepunk Inn, at Snowshoe, West Virginia. Field trips were made to the wetlands at Cranberry Glades, shale barrens at Whites Draft, mature Red Spruce forest at Gaudineer Knob, floodplains along Shaver's Fork of the Cheat River, and the rocky summit of Spruce Knob. Evening programs dealt with the flora and the geology of West Virginia. Chairman: Yvette Ogle.

June 30: Clementon and Vicinity, Camden Co., NJ. We traveled the haunts of earlier botanists exploring the remnants of a once rich flora. The first stop on the trip was to the eastern edge of Clementon, at the railroad stop known as Sumner. It was a botanizing area for botanists during the first half of this century. A walk along the railroad right-of-way showed the evidence of herbicide use for track maintenance. Many trees on the edge of the tracks were distorted and yellowed by the applications probably meant to clear herbaceous plants. This practice has, however, eliminated many of the common wild flowers once found here. Diligent searching yielded *Lupinus perennis, Euphorbia impecacuanhae, Cayra pallida, Tephrosia virginiana, Solidago uliginosa* and *Asclepias tuberosa* and *A. amplexicaulis* in addition to many common trees and shrubs commonly associated with the western edge of the Pine Barrens. Once the group felt it had seen enough of this site, the trip moved to a small NJ Fish and Wildlife Management Area known as Rowand's Pond.

This area is located on the Trout Branch of the North Branch Timber Creek. The management lands straddle the Inner and Outer Coastal Plains, thereby yielding an interest botanical mix in forest composition and aspect. This area, too, was highly impacted by the surrounding urbanization. Shopping carts and tires marked the edge of the wetlands, signaling a new set of wetland indicators. Intermixed with this trash, was an interesting mix of aquatic and terrestrial plants. The pond supported a dense growth of *Cabomba caroliniana, Myriophyllum spicatum*(?), *Sparganium americanum, Nuphar lutea* and *Nymphaea odorata.* An interesting spike rush was growing by an old spillway, which was tentatively identified as *Eleocharis palustris* or *E. smallii.* An interesting forest of *Fagus grandiflora, Quercus falcata, coccinea, alba, prinus, velutina* and *Pinus virginica, rigida* was noted as the group investigated an interesting association of *Xerophyllum asphodeloides, Medeoda virginiana, Aralia nudicaulis* and *Maianthemum canadense.*

The last stop on our trip was the lowland associated with the headwaters of Mason Run. This area was located between Erial Road and Branch Avenue, south of Blackwood-Clementon Road. This site was of particular interest because of a red maple lowland forest co-dominated by *Quercus michauxii*. After investigating this habitat, an inspection of a powerline right-of-way was made which lead the group south to an abandoned gravel and sand mine where *Carex bushii* was found associated with many interesting Coastal Plain grasses and sedges. Leader: Joe Arsenault

July 28: Miller Bogs at Dutchtown, Atlantic Co., and Lower Forge Savannahs, Burlington Co., NJ. We were joined by members of the Botanical Society of Western PA and various other guests whose special interest was seeing orchids. In the vicinity of the Miller cranberry bogs near Atsion, a flowering cluster of six *Platanthera blephariglottis* attracted many photographers in the group. Among the numerous species observed in this lowland pitch-pine complex were *Leiophyllum buxifolium, Hypericum densiflorum, Minuartia caroliniana, Muhlenbergia torreyana, Calamovilfa brevipilis, Amphicarpum purshii, Xerophyllum asphodeloides, Lachnanthes tinctoria, Polygala lutea, Lobelia nuttallii, Juncus biflorus, Carex bullata,* and *Cyperus dentatus*. After eating lunch on a bank of the Batsto River, we successfully searched a bog-ore savannah above Lower Forge for *Platanthera cristata, P. clavellata,* and *P. blephariglottis*. Other species encountered included *Calopogon tuberosus, Pogonia ophioglossoides, Lophiola americana, Sabatia difformis, Narthecium americanum, Schizaea pusilla, Scleria muhlenbergii, Rhynchospora oligantha, R. cephalantha,* and *Eleocharis tuberculosa*. Leader: Ted Gordon.

August 4: Pecks Pond and Little Mud Pond, Pike Co. PA. On the first day of this overnight field trip we visited two glacial bog communities. The bog at Pecks Pond is an impressive 40 acre spongy mat dominated by *Chamaedaphne calyculata*. The group explored the mat and we found an excellent population of the state-threatened *Carex paupercula*. Scattered throughout the bog we also found *Aronia melanocarpa, Calla palustris, Carex trisperma, Cicuta bulbifera, Drosera rotundifolia, Eriophorum virginicum, Kalmia angustifolia, K. polifolia, Rhododendron canadense, Rhynchospera alba, Sarracenia purpurea,* and *Vaccinium macrocarpon*. Floating in the water we found the verticillate leaves of *Utricularia purpurea*. Sphagnum species included *S. magellanicum, S. rubellum,* and *S. torreyanum*. After lunch our group of intrepid botanists ventured on to the bog mat at Little Mud Pond where we found many of same species encountered at Pecks Pond. On the treacherous open areas of the bog mat we found two state-rare plants, *Andromeda polifolia* and *Xyris montana*. Another state-rare plant, dwarf mistletoe *Arceuthobium pusillum,* was found growing as a parasite on *Picea mariana*. New species encountered include *Carex canescens, Drosera intermedia, Larix laricina, Menyanthes trifoliata, Utricularia cornuta,* and *Vaccinium oxycoccos*. Participants who spent the night at Lake Lacawac Sanctuary were able to canoe the perimeter of the lake and see *Sparganium angustifolium, Eleocharis robbinsii, Nymphoides cordata, Brasenia schreberi* and, from a safe distance, *Toxicodendron vernix*. Leader: Greg Edinger.

August 5: Bushkill Shale Cliffs, Pike Co., PA. In contrast to the previous day of wet walking in bogs, our second day presented our group with a rigorous hike to the top of Bushkill Shale Cliffs. Here we found an excellent example of an acidic shale cliff community with a large stand of *Opuntia humifusa* growing along the edge of the cliff in loose shale talus. The cliff offered an impressive view of the Delaware River 300 feet below. A few adventurous members traversed the slope and found *Aquilegia canaden-*

sis, Arabis lyrata, Asclepias verticillata, Asplenium platyneuron, A. trichomanes, Baptisia tinctoria, Carex pensylvanica, Campanula rotundifolia, Commandra umbellata, Corydalis sempervirens, Cunila origanoides, Danthonia spicata, Deschampsia flexuosa, Erichtites hieracifolia, Helianthus divaricatus, Paronychia sp., *Polypodium virginianum, Pycnanthemum incanum, Tephrosia virginiana, Woodsia ilvensis,* and *W. obtusa*. Scattered along the slope were dwarf specimens of *Juniperis virginiana, Carya glabra, Pinus rigida, Quercus montana,* and *Q. velutina*. Leader: Greg Edinger.

August 18: Lower Maurice River, Cumberland Co., NJ. This trip began at the Mauricetown Bridge where adjacent to the vast expanse of marshes, fine stands of *Sabatia stellaris* were in bloom. The following species were found growing with the *Sabatia: Chenopodium album, Cyperus filicinus, Eragrostis spectabilis, Euthamia tenuifolia, Kummerowia striata, Panicum virgatum,* and *Samolus valerandi* ssp. *parviflora*. A single specimen of *Taxodium distichum,* previously planted by local tree enthusiast Stephen Field, was noted adjacent to the Maurice River.

After botanizing by the bridge, the group then walked along the Maurice River Causeway enroute to the railroad tracks. Along the road, the group saw a stand of *Tamarix gallica,* a non-native species, growing on the edge of a marsh. Upon reaching the railroad tracks, the group followed them south into a tidal marsh. In the marsh, the group enjoyed the blooms of *Hibiscus moscheutos* and *Kosteletzkya virginica* growing with *Zizania aquatica*. Adjacent to the marsh the group noticed a stand of *Pinus taeda*. The stand appeared to be native; native stands of *P. taeda* are a rarity in New Jersey. Also adjacent to the marsh, the group puzzled over a *Rhynchospora,* which later was identified as *R. gracilenta*.

After lunch the group visited a salt marsh at the terminus of Hansey Creek Road near Turkey Point. In the marsh, the following species were recorded: *Agalinus maritima, Amaranthus cannabinus, Aster subulatus, Limonium carolinianum, Salicornia europea, Spartina patens, S. alterniflora, S. cynosuroides,* and *Scirpus robustus*. In a hardwood swamp along Hansey Creek Road, the group noted a stand of the state-endangered *Quercus nigra,* growing with more common hydric tree species such as *Acer rubrum, Nyssa sylvatica,* and *Liquidambar styraciflua*.

The group's next stop was a salt hay farm in Port Norris. Here the group was able to see vast stands of *Distichlis spicata*. In areas that were not farmed for salt hay, large stands of *Phragmites australis* occurred. In these stands of *Phragmites,* many individuals of the state-rare *Setaria magna* were noted. *Echinochloa walteri* was also at the salt hay farm.

The group then travelled to the West Creek Baptist Cemetery and noted the state-rare *Stylosanthes biflora* in bloom. Other species noted at the cemetery include: *Aster concolor, A. gracilis, A. patens, A. solidageneus, A. vimineus, Euthamia graminifolia, E. tenuifolia, Scleria triglomerata, Solidago canadensis, S. erecta, S. juncea, S. odora,* and *S. puberula*.

The group's final stop was along the Manantico Creek, near the fish and game lands. Here in the uplands the group noted a few patches of *Pyxidanthera barbulata* (a rare species in Cumberland County) growing with *Quercus alba, Q. stellata, Pinus rigida, Gaultheria procumbens, Gaylusaccia baccata, G. frondosa,* and *Vaccinium pallidum*. In freshwater tidal wetlands along the Manantico, the group saw an excellent display of summer wildflowers, including: *Asclepias incarnata, Oxypolis rigidior, Sagittaria graminea, Rhexia mariana,* and *R. virginica*. The following rare species were also noted in the freshwater tidal marsh: *Elatine americana, Eriocaulon parkeri, Gratiola virginiana,* and *Isoetes riparia.* As evening settled in, the group left the marsh, crossed vast areas of sand (left from past sand mining operations) where only *Hudsonia ericoides, H. tomentosa,* and *Polygonella articulata* occurred, and headed back to their automobiles. Leader: Gerry Moore.

August 26: Great Bay Wildlife Management Area, Ocean Co., NJ. This trip met by the shores of Lake Pohatcong in Tuckerton, where *Cyperus flavescens, Hypericum boreale,* and *Sagittaria engelmanniana* were found. Heading east along Great Bay Boulevard, a section of high marsh was visited, where some of the plants seen were *Scirpus robustus, Eleocharis rostellata, Fimbristylis castanea, Spartina cynosuroides, Setaria geniculata, Juncus gerardi, Pluchea odorata, Aster tenuifolius, Sabatia stellaris, Limonium carolinianum, Plantago maritima, Agalinis purpurea,* and *Agalinis maritima. Polygonatum biflorum* var. *commutatum* was found growing in a dense thicket of *Toxicodendron radicans* atop an Indian shell mound. Three species of *Salicornia—S. europaea, S. bigelovii,* and *S. virginica*—were seen and compared. A long walk to the shore, necessitated by bridge closings, failed to turn up the *Honckenya peploides* that grew here until at least 1988; it appears that erosion and natural reshaping of the shore, rather than human disturbance of the beach area, is the cause. *Salsola kali, Atriplex arenaria, Bassia hirsuta, Chamaesyce polygonifolia,* and *Kosteletzkya virginica* were noted en route. The weather was warm, but ocean breezes made for pleasant walking and kept troublesome insects to a minimum. Leader: Karl Anderson.

September 1: Bennett Bogs Nature Preserve, Cape May Co., NJ. The third annual trip lead to these Atlantic Coastal Plain intermittent pond communities once again found the ponds under water for the second straight year. Species found included: *Utricularia radiata, Eleocharis quadrangulata, Eleocharis melanocarpa,* and *Eleocharis microcarpa.* Several rare plant species previously known from this location, such as *Platanthera nivea,* were not found. A historical listing of species found in the Preserve was given to those who attended. Leader: William Olson.

September 8: Hamilton/Trenton Marsh, Mercer Co., NJ. (Joint trip with Torrey Botanical Club.) The focus of this trip was ~1.5 mi of wetland edge adjacent to a partially constructed interstate interchange where disturbance began in 1985. Other habitats included sandy interchange surface, forested upland, tidal freshwater marsh and shrub forest, and, at days end for a few tireless individuals, the edge of Spring Lake. These provided a rich variety of plant species.

There were 12 *Polygonum* species (*P. amphibium, P. arifolium, P. caespitosum, P. cuspidatum, P. hydropiperoides, P. lapathifolium, P. pensylvanicum, P. persicaria, P. punctatum, P. sagittatum, P. scandens,* and *P. virginianum.* Composites were also abundant and included: *Ambrosia trifida, Aster puniceus, Bidens connata, Bidens laevis, Bidens polylepis, Centaurea vochinensis, Erechtites hieracifolia, Eupatorium dubium, Eupatorium hyssopifolium, Eupatorium maculatum, Eupatorium perfoliatum, Eupatorium rotundifolium, Eupatorium rugosum, Mikania scandens, Solidago graminifolium, Solidago juncea, Solidago nemoralis, Solidago sempervirens,* and *Solidago rugosa.* Of particular interest was *Eupatorium altissima* which is expanding its range. Ferns included: *Athyrium felix-femina, Botrychium dissectum, Onoclea sensibilis, Thelypteris noveboracensis,* and *Woodwardia areolata.* Miscellaneous other species included: *Amaranthus cannabinus, Arthraxon hispidus, Carex comosa, Carex lurida, Cicuta bulbifera, Eclipta alba, Echinochloa muricata, Eleocharis obtusa, Gerardia tenuifolia, Heteranthera multiflora, Scirpus fluviatilis, Sparganium eurycarpum,* and *Zizania aquatilis.* In addition to a plant of *Lactuca biennis* more than 4 m tall, individuals of *Agastache nepetoides* and *Scrophularia marilandica* exceeded 2 m. These species compensated those who grumbled while traversing the ''uninteresting'' hillside. We thank Karl Anderson, Ted Gordon, and Bill Olson for serving as co-leaders. Leaders: Mary and Charles Leck.

16 September: Atsion Lake, Burlington Co., NJ. We visited several interesting wildflower sites in Wharton State Forest. Some sites were the same as the June 17th trip. In bloom were *Gentiana autumnalis, Liatris graminifolia, Solidago stricta* and *Euthamia tenuifolia.* We went into the lake area and had lunch. Among the species found in the lake area were *Rhexia mariana, Rhexia virginica, Polygala lutea, Pontederia cordata,* and many other plants. Leader: John Ballas.

Bartonia No. 57: 113–117, 1992

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Program of Meetings 1990

1990	*Subject*	*Speaker*
25 Jan	Flora of the Austrian Alps	Larry H. Klotz
22 Feb	Jenkins Arboretum and Environmental Horticulture: Ornamental Use of Diverse Native Plants on a Public Garden Scale	Harold E. Sweetman
22 Mar	The Life and Times of John Torrey (1796–1873)—Great American Botanist	Lawrence H. Crockett
26 Apr	The *Sphagnum* Flora of New Jersey	Eric F. Karlin
24 May	Some Plants of Western South America from Cape Horn to Galapagos	Howard P. Wood
27 Sep	Slide Illustrated Report of Summer Botanizing	Club Members
15 Nov	Flowers of the Continent: A Floristic Record of a Trip from the Atlantic to the Pacific	Heinrich Zoller Ann Newbold
20 Dec	Gradient Analysis of Pitch Pine Lowland Communities in the New Jersey Pine Barrens	Robert Zampella